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ESSENTIAL FACTORS IN THE OCCURRENCE AND THE MITIGATION OF  
OCCUPATIONAL DEAFNESS

BY



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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES  
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF MASTER OF ARTS

FACULTY OF PHYSICAL EDUCATION

EDMONTON, ALBERTA

SPRING, 1969



UNIVERSITY OF ALBERTA  
FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Essential Factors in the Occurrence and the Mitigation of Occupational Deafness", by Patrick Firmin Demeyere in partial fulfilment of the requirements for the degree of Master of Arts.



## ABSTRACT

Research into the occurrence of occupational deafness has been limited to fragmented contribution by a few disciplines only, such as acoustics, otology, ergonomics, etc.

An investigation model is developed on basis of the interaction between the management, the labor force, and the authorities which are responsible for occupational health. This triangular basis is expanded to five levels, i.e., the individual, the employment, the state, the national, and the international levels. Five more indicators are introduced which are: participation, roles, general non-technical causes, specific non-technical causes, communication.

A series of factors are discussed and proposed for further investigation. They are: conceptualization, responsibility taking, priority to action, standardization, cost to management, employer - employee relationship, interpretation of the work condition by the employee, contribution of the state health authority.

A set of communication channels are discussed between the state health authority and the individual worker.



## ACKNOWLEDGEMENTS

Many individuals have contributed towards the completion of the thesis. Possibly the language barrier of the author has prevented the thesis from achieving a high standard of quality.

I would particularly like to thank Professor A. Eriksson for his constant faith and contribution in helping to develop the thesis to acceptable English standards.

I am grateful to Dr. H. Buchwald, Dr. M. Hendrickson, and Dr. R. Wilberg for their guidance and constructive criticism throughout the writing of this thesis.

My sincere thanks to those involved in occupational health, whose published works have been of great assistance.





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## CHAPTER I

### STATEMENT OF THE PROBLEM

#### Introduction

Occupational noise and deafness have, in the last two decades, received increased attention from the general public, the industrial population, the medical and legal authorities and other specialists. The medical profession and the acoustical sciences have been the major contributors to an awareness of excessive noise levels in industry. However, occupational noise and deafness are not eliminated yet. Why is this so?

There is a need to review the problem as an entity in which various facets such as lack of conceptualization, lack of responsibility taking, the need for standardization, work environment attitudes, pressure on management, and others, are part of the total picture.

The following chapters consist of the gradual development and justification of a preliminary model with which the occurrence of occupational deafness can be analyzed systematically. A series of essential elements is proposed and justified in the investigation of occupational deafness and should be generally applicable to other occupational health hazards.

#### Purpose of the Study

The purpose of the study is:

- 1) To develop a preliminary model to make possible the analysis of the occurrence of occupational deafness on a basis of





individual and social involvement by the employer, the employed, and the authorities having the responsibility for preventing occupational health hazards.

2) To propose and substantiate essential elements about which quantitative and qualitative evidence is needed.

3) To illustrate the nature of occupational deafness.

### Justification of the Study

Occupational deafness is basically a social problem in which the skilled and unskilled labor force, the management of large and small industries, the medical profession and other health workers all have a part. Industrial social psychologists and educators, unions, government representatives, acousticians, and others, are also involved, as well as public opinion.

There is no value using the evidence of a limited number of research areas in order to modify the impact of occupational noise and deafness on the workers. All involved parties, their roles, their ways of acting, their influencing milieus, their impact on other parties, have to be located in a comprehensive and simple reference structure. At the present time there is no standardised model for applying systematic research into the occurrence and prevention of occupational deafness. The School Health Education Study (97:12) mentions:

Knowledge about the status of all existing conditions is fundamental to any plan of action for program improvement.

What is occupational deafness? This question is dealt with because the people who undergo it, the people who cause it, and the people who have to eliminate it, have to be aware of the harmful ef-





fects. Beales (9:176), and other authors, mention that noise and deafness are generally considered as a mere nuisance. This is one of the basic problems in the mitigation of this condition. A large number of involved people misjudge the mental and social impact on the afflicted person by the insidious hearing loss. If occupational deafness is only a mere nuisance, then a considerable amount of work has been wasted. If occupational deafness is not a mere nuisance, then it is now time that information about this affliction is communicated to all people who are involved.

### Delimitations

1) The proposed model is limited to the contribution of management, the labor force and the individuals or groups of personnel involved in occupational health prevention.

2) The occurrence of occupational deafness is not handled in terms of acoustical and otological causality although basic concepts and information will be used as supplementary material.

3) The model, the proposal of essential elements, and suggestions raised for further research, are developed on the basis of evidence collected from occupational health literature and personal contacts with industrial health authorities.

### Limitations

1) The dynamic character of the social occupational deafness problem apparently gets lost in the static presentation of the model. The structure of the study is to put the causal and essential factors in their true relationship.



2) Information is limited to literature sources and to personal contacts with health authorities who specialize in the study of the occupational deafness problem. Preference is given to the theoretical development instead of field work, because the immediate need is not to have data, but to prepare a structure in which existing and future evidence can be located.

3) If discussed elements in the model are not fully explored or are biased, they should still hold their essential character as an indicator for follow-up studies. However, personal bias has been reduced through the help of authorities in occupational health. The complete scheme is such that omitted essential elements can still be added without major changes in the proposed model.

### Methods and Procedure

The development of the structure and the proposed essential factors for continued investigation are drawn from:

1) Information gained from authorities involved in the field of occupational health and specifically in the mitigation of occupational deafness.

2) Information gained from literature on occupational health and the prevention of occupational deafness.

3) Information gained from personal correspondence with institutions specializing in research on the cause and prevention of occupational deafness.

The proposal of the model, and the essential elements for further research, are the result of continuous refinement and consultation with specialists in the field. Attention is paid to continu-





ous justification of the step by step development of the model.

## Definition of Terms

### Acoustic, Acoustical

The qualifying adjectives "acoustic" and "acoustical" mean containing, producing, arising from, actuated by, related to, or associated with sound. Acoustic is used when the term being qualified designates something that has the properties, dimensions, or physical characteristics associated with sound waves; acoustical is used when the term being qualified does not designate explicitly something that has properties, dimensions, or physical characteristics (3:160).

### Acoustics

Acoustics is the science of sound, including its production, transmission, and effects. The acoustics of a room are those qualities that together determine its character with respect to distinct hearing (3:160).

### Damage Risk Criterion

A damage risk criterion specifies the maximum allowable exposure to which people may be exposed if risk of hearing impairment is to be avoided. A damage risk criterion may include in its statement a specification of such factors as time of exposure, noise intensity, and frequency, amount of hearing loss that is considered significant, percentage of the population to be protected, and method of measuring the noise (3:160).

### Decibel

The decibel is a dimensionless unit used to express a logarithmic ratio between a measured quantity and a reference quantity (3:161). dBA is the unit of measurement of sound level, using frequency weighting network A (20:156). Measurement by simple sound-level meters, without summation weightings for different frequencies, produces an intensity reading lower than the perceived loudness (89:16).

### Employee

The employee (Ee) is the person or the group of persons who produce goods or render services and are appointed by the employer.



The Ee is subjected to a more or less harmful noise exposure. There is no specific distinction made in this study concerning the socio-cultural, the socio-economic, educational, and other strata.

### Employer

The employer (Er) is the person or the group of persons who produce work with the appointed personnel. In this study the workers under their authority are considered as being exposed to excessive noise.

### Employment

The employment is, according to the American College Dictionary, the act of employing, that on which one is employed.

### Health Provider

The health provider (HPr) is the person or the group of people who are participating in the mitigation of occupational deafness, either directly or indirectly. Health providers work on individual, employment, state, national, and international levels. HPr represents also the function of providing health. The World Health Organization defines health as a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity.

### Hearing Loss

The hearing loss of an ear at a specified frequency is the amount, in decibels, by which the threshold of audibility for that ear exceeds a standard audiometric threshold (3:161).

### Intensity Level

The intensity level, in decibels, of sound is 10 times





the logarithm to the base 10 of the ratio of the intensity of this sound to the reference intensity. The reference intensity shall be stated explicitly. A common reference sound intensity is  $10^{-16}$  watt per square centimeter in a specified direction (3:161).

#### Loudness

Loudness is the intensive attribute of an auditory sensation, in terms of which sounds may be ordered on a scale extending from soft to loud. Loudness depends primarily upon the sound pressure of the stimulus, but it also depends upon the frequency and wave form of the stimulus (3:161).

#### Microbar, Dyne per Square Centimeter

A microbar is a unit of pressure commonly used in acoustics. One microbar is equal to one dyne per square centimeter (3:161).

#### Occupational and Industrial Noise

Occupational or industrial noise is the noise inherent in the industry or the occupation and which is considered as damaging the hearing of the exposed workers. Essential characteristics are the intensity, the frequency distribution, the duration, and the temporal pattern.

#### Occupational Deafness

Occupational deafness (OD) is the temporary or the permanent loss of hearing acuity due to the prolonged exposure to high intensity noises inherent to the job (68). Prolonged exposure means also the resultant of many short time exposures. Occupational deafness is an affliction with physiological, psychological and sociological characteristics. Other terminology frequently used in the literature is:

Occupational hearing loss

Industrial deafness



## Noise induced hearing loss

Threshold shift, permanent (PTS) or temporary (TTS)

Occupational deafness can be measured with an audiometer. The audiometer produces sounds of different frequency and intensity and which usually compares the threshold with that of a normal-hearing individual. If an audiometer records a loss of 20 dB at 1,000 cps it simply means that the threshold of the individual tested is 20 dB above the statistical zero, which is held to represent normal hearing at that frequency (89:28).

### Per Cent Impairment of Hearing

Per cent impairment of hearing is an estimate of a person's ability to hear correctly. It is usually based by means of an arbitrary rule, on the pure tone audiogram. The specific rule for calculating this quantity from the audiogram now varies from state to state according to rule or law (3:162).

### Pitch

Pitch is that attribute of auditory sensation in terms of which sounds may be ordered on a scale extending from low to high. Pitch depends primarily upon the frequency of the sound stimulus, but it also depends upon the sound pressure and wave form of the stimulus (3:162).

### Phon

The phon is the smallest variation of sound perceptible to the human ear. And the range of audible sounds between the threshold of audibility and the point at which the sound causes pain is generally estimated as 120 phons (102).

The phon is the unit of loudness level when

- a) the standard pure tone is produced by a sensibly plane sinusoidal progressive sound wave coming from directly in front of the observer and having a frequency of 1,000 cps, and
- b) the sound pressure level in the free progressive wave is expressed in decibels above  $0.0002 \text{ dyn/cm}^2$ .



### Recruitment

The condition (usually characteristic of nerve deafness) where faint or moderate sounds cannot be heard while at the same time there is little or no loss in the sense of loudness of loud sounds. It explains why old people, whose deafness is usually a gradual high-toned nerve deafness, complain in one moment that they cannot hear a speaker and at the next moment when he raises his voice, that he is shouting too loudly at them (3:162).

### Sound.

Sound is defined in two ways:

- a) The sensation of hearing stimulated by mechanical disturbance.
- b) The physical cause of hearing sensation, namely vibrating waves propagated through the atmosphere or other medium or vibrations that cause sound waves.

This dual nature of sound, partly physical and partly subjective, is responsible for most of the difficulties which arise in its measurement (14).

### Sound Pressure Level

The sound pressure level, in decibels, of a sound is 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure. The reference pressure shall be explicitly stated (3:163).





## CHAPTER II

### NATURE OF THE OCCUPATIONAL NOISE AND DEAFNESS PROBLEM

#### 1. Progress and Limitations in the Mitigation of Occupational Deafness

Attention has been drawn to occupational deafness since the end of the second world war because:

a) The increase of mechanical power and high-speed work procedures have resulted in a rise of the occupational noise, and subsequently, in a higher incidence of occupational deafness.

Glorig (53)(38) states:

The potential cost of noise induced hearing loss to industry is greater than for any other occupational disease.

Jones and Cohen (53) state:

Despite numerous proposals, definitive criteria for judging the adverse effect of noise have not been established in contrast to toxic chemical agents, which pose problems specific to certain industries, noise is one of the few environmental hazards common to nearly all industries.

Davies, Davis, Tyrer (22) mention:

Man has developed the capacity for changing the environment faster than he has been able to adapt himself to the conditions which he himself has brought about.

b) Accurate and portable means of measuring noise levels are now available.

c) The knowledge of the detrimental effect of noise is closely studied and the clinical characteristics of occupational deaf-





ness are better known.

d) The accuracy in audiometry now allows one to make valid measurements of the remaining hearing acuity of deafened workers.

e) Workers represented through unions ask for better protection against excessive noise on the job. Workmen's compensation boards and employers want to secure themselves through the use of pre-employment audiometric tests and regular controls.

Occupational deafness is far from eradicated because:

a) The number of noisy work conditions is rising yearly. The hazard has increased to harmful levels even in a number of employments which have been considered in the past as noise free, for example, farming. Jones and Cohen (53) mention that according to Knudsen, the noise level in the United States is increasing yearly at a rate of one decibel.

b) The reduction of noise to safe levels is not always technically or economically possible.

c) Authors involved in audiometry and occupational health agree that the workers adapt easily to noise. The general public has accepted through the years a rise of noise which has resulted in hearing loss. The Committee on the Problem of Noise states in the Final Report (20):

A noise originally annoying or disturbing becomes tolerated and even unnoticed by most people when it has become sufficiently familiar. Without this convenient process of adaptation, resentment against noise in modern society would be much greater than it is at this moment. Nevertheless there are some people who are more sensitive than most to noise.

Glorig, Grings and Summerfield (39) have coined the term "Sociocusis"



for that hearing loss produced by noise exposure not greater than that found in ordinary environmental social situations. These authors state:

Sociocusis is causally related to noise exposure encountered in non-occupational pursuits and/or in occupations where the noise levels do not ordinarily exceed those found in our social environment. The noise exposure in most offices, for example, are less than the exposures one encounters in many social and domestic activities, such as riding in an automobile with open windows, operating washing machines, vacuum cleaners .....

Maas (69)(70) mentions that 27 per cent of the applicants for jobs have hearing difficulties. There is no specification given for the age level, but it is almost certain that all applicants will not be old people, according to Buchwald (14).

d) The protective legislation varies from country to country, in Northern America, even from state to state. This weakens the progress of the mitigation of OD.

e) An unknown but probably a large segment of the industrial population, as well employers as employees, does not know about the occurrence of the noise hazard and its consequences.

f) There is a lack of insight in the mental and social impact of occupational deafness, not only among workers and employers, but also among health providers.

Occupational deafness is the consequence of a multifaceted social problem that at the present time has been approached fragmentally, empirically, but not conceptually or on an organized basis, because of lack of an instrument with which the dimension can be evaluated. It is desirable to examine this health hazard in its total appearance before priority is given to action.



## 2. The Potential Occupational Noise Exposure

Occupational noise is the vibration of aircrafts and is characterized by its frequency and amplitude. Damage occurs to human hearing when some combinations of the properties surpass safety limits, which are called damage risk criteria. The cause of the vibrations lies in the energy which escapes in an uncontrollable way from mechanical processes. A higher energy loss in the form of noise can be expected on the job. For example, testers of jet engines are exposed to higher intensities than are car-motor testers.

The problem of defining noise does not only originate from the physical nature of sound, but also from its psychological properties.

Lehmann (59) states:

What makes sound a noise is a matter of psychology rather than acoustics. A sound which we associate with something pleasurable is far less likely to be considered as a noise than one with unwelcome connotations. We always tend to moderate the noise of our car. The children next door always seem to make more noise than our own. So whether a sound is regarded as a noise and how noisy it is depends on who causes the noise and the relationship with the person who bears it.

Glorig (89:2) states:

The essential characteristic of noise is its undesirability.

Rodda (89:2) and the American Industrial Hygiene Association (3:162) define noise as unwanted sound. The vibration which escapes from mechanical procedures is labeled as the potential occupational noise exposure (PONE). The continued increase of PONE throughout an entire country is not yet factually or numerically substantiated, but





estimations can be based on the registered noise levels of mechanical procedures and the number of work procedures present (14).

Sataloff (91:296) classifies occupations with PONE on the following basis:

The plant has no intense noise hazardous to hearing.

The plant has a possible or definite noise hazard in only a few of the operations, and these involve only a small group of employees.

The plant has numerous operations producing intense noise most of which seem to be borderline in nature as to their effect on hearing. (Conversation is possible by loud speech).

The plant has an extensive noise problem involving many employees and very intense noises. Some of this group may already be involved in medico-legal problems because of claims for occupational deafness.

The following PONE distinctions are made on evidence from Sataloff (91:78) and the American Industrial Hygiene Association (3:34).

#### Steady Noise

Steady noise has no rapid or sudden changes in frequency and intensity. Many occupational noises belong to this group, for example, motor noise or air moving through ducts. Human hearing adapts easily to this type of noise.

#### Intermittent Noise

Intermittent noise results from variations in the operation of equipment or from steady noise sources passing by the observer, for example, motor testing, or passing traffic.

#### Impulse or Impact Noise

Impulse or impact noise is characterized by a rapid change in intensity during a very short time. Impact noise is perceived when a hammer strikes the anvil, by use of punch presses, or by gunfire. The





intensity of this type of noise is difficult to measure because the sound level meter is too slow to record the peak values. The sound pressure level can be 20 or 30 dB higher than the highest reading.

### Repeated Impact or Impulse Noise

Repeated impact or impulse noise is an intermediate between steady noise and impulse noise. It is generally produced by the use of pneumatic hammers or rivetery. The repeated impact noise can be measured as steady noise, as soon as the frequency of the impulses exceed 200 times per second (33:288).

Some PONE levels are combined from data by the Department of National Health and Welfare in Canada (25), Gafafer (33), and Sataloff (91:16). They are set up in table I. More specific PONE levels, related to factories only, are presented in table II. These data are collected by the National Physical Laboratory of the Control of Noise in England. The PONE levels are expressed in dB weighting scale A, in Phons, and in International Standard Organization units (89:25).

### 3. Modification of the Potential Occupational Noise Exposure

PONE can be modified in two ways, i.e. increase or decrease of the exposure to the potential noise level. The former is more harmful to hearing than before the change, the latter is more safe to human hearing. The resultant is called the actual occupational noise exposure (AONE). The mitigation is possible through four channels:

Modification of the noise source

Manipulation of the noise source



## Sound Pressure Level in dB 0.0002 microbar

	150	
	140	Threshold of pain
Hydrolic press at 3 ft		
Large pneumatic riveter at 4 ft	130	Boilershop maximum level
Pneumatic chipper at 5 ft	120	Drophammers, chipping
Multiple sand blast unit at 4 ft		Engine room submarine fullspeed
Trumpet autohorn at 3 ft		Jet engine test control room
Automatic punch press at 3 ft	110	Wood working shop
Chipping hammer at 3 ft		Weaving room
Cut off saw at 2 ft		
Annealing furnace at 4 ft	100	Can manufacturing plant
Automatic lathe at 3 ft		Screw machines, punchpresses
Subway train at 20 ft		Cut-off saws, riveters
Heavy trucks at 20 ft	90	Inside motor bus
10 HP out board motor at 50 ft		
Light trucks in city at 20 ft	80	Office with tabulating machines
	70	
conversational speech at 3 ft		
	60	
	50	Average residence
	40	
	30	Broadcasting studio speech
	20	
	10	
		Threshold for audibility of
	0	1,000 cps pure tone

table 1

Common Overall Sound Levels Recorded in Public and Work Situations.





Typical Noise Levels Recorded in Factories Using Weighting scale A of sound level meters Loudness scale by use of Stevens method International Standard Organization unit			
Work situation	Sound level dBA	Loudness phons	I.S.O.
Boiler works, hammering	118	127	115
Metal power works	114	125	113
Steel works, fettling	114	125	113
Metal saw	110	122	110
Wood planing machine	108	119	105
Metal working shop, grinder	106	117	104
Weaving shed	104	117	103
Sweet coating machine	102	116	104
Srew heading machine	101	114	99
Envelope machine	99	110	100
Castings falling into bin	97	110	96
Diesel electric generator house	96	109	94
Printing works	96	109	93
Automatic lathes	87	99	84

table II

Typical Noise Levels Recorded in Factories.





Education of the health provider, to the employer, and to the employee

Modification of the legislation

The PONE to AONE change is represented in figure 1.

#### Modification of the Noise Source

Van Wely and Willems (107:113), Johnston (52), Michaels (75:7), and other authors, recommend the redesign of equipment, work procedures and work environment as the primary PONE modification. They demand attention to be paid to potential noise sources in the planning period on the basis of experience with the previous models and with the acoustical research evidence available. The Committee on the Problem of Noise (20) mentions that the present technical knowledge is usually satisfactory but is not always efficiently used. The policy of building the machines first and changing them afterwards is basically wrong, but nevertheless the most common way of acting. In the noise regulations act for housing as applied in the Netherlands, projects are turned down when they do not fulfill the noise insulation requirements. Hoad (46) mentions that West Germany has introduced prescribed noise levels for machinery items. The same author gives a few examples of PONE change at the noise source:

- Riveting replaced by welding.
- Drop stamps and steam- and air-hammers for dropforging can be replaced by the lesser sounds of mechanical presses.
- Plastic parts have succesfully quietened the literally deafening din of weaving sheds.

The extra expense incurred by the employer on noise abatement may seem to be excessive, but he can save money by avoiding replacement or change of work procedures, claims filed by his employees and neighborhood com-



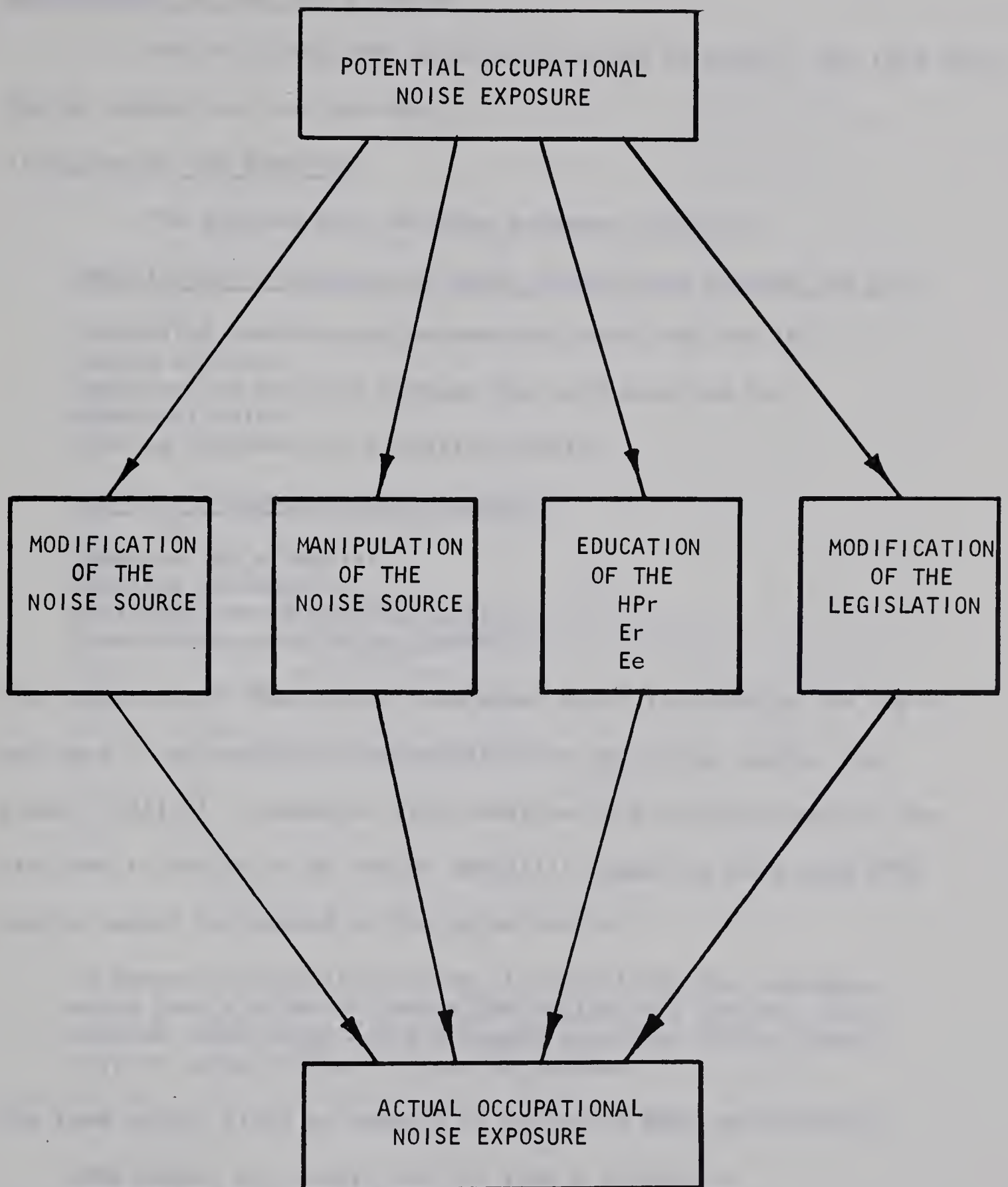


figure 1

Modification of the Potential Occupational Noise Exposure through Four Channels.



plaints.

### Manipulation of the Noise Source

The following PONE modifications can be used in the case that design changes are not possible.

#### 1) Action by the Employer

The Subcommittee on Noise proposes (103:16):

##### Reduction of the Amount of Noise Transmitted through the Air

Increasing the distance between the work area and the source of noise  
Constructing barriers between the work area and the source of noise  
Placing equipment on vibration mounts

##### Revision of Operational Procedures

Changing job schedules  
Rotating personnel  
Enclosing remote control stations  
Constructing observation booths

The reduction of PONE levels from power plant turbines by the use of barriers is an example of manipulation of the noise source. See graph I (2)(14). Stramentov (102) mentions the factory planning regulations in the Union of Soviet Socialist Republics when high PONE levels cannot be reduced at the noise source.

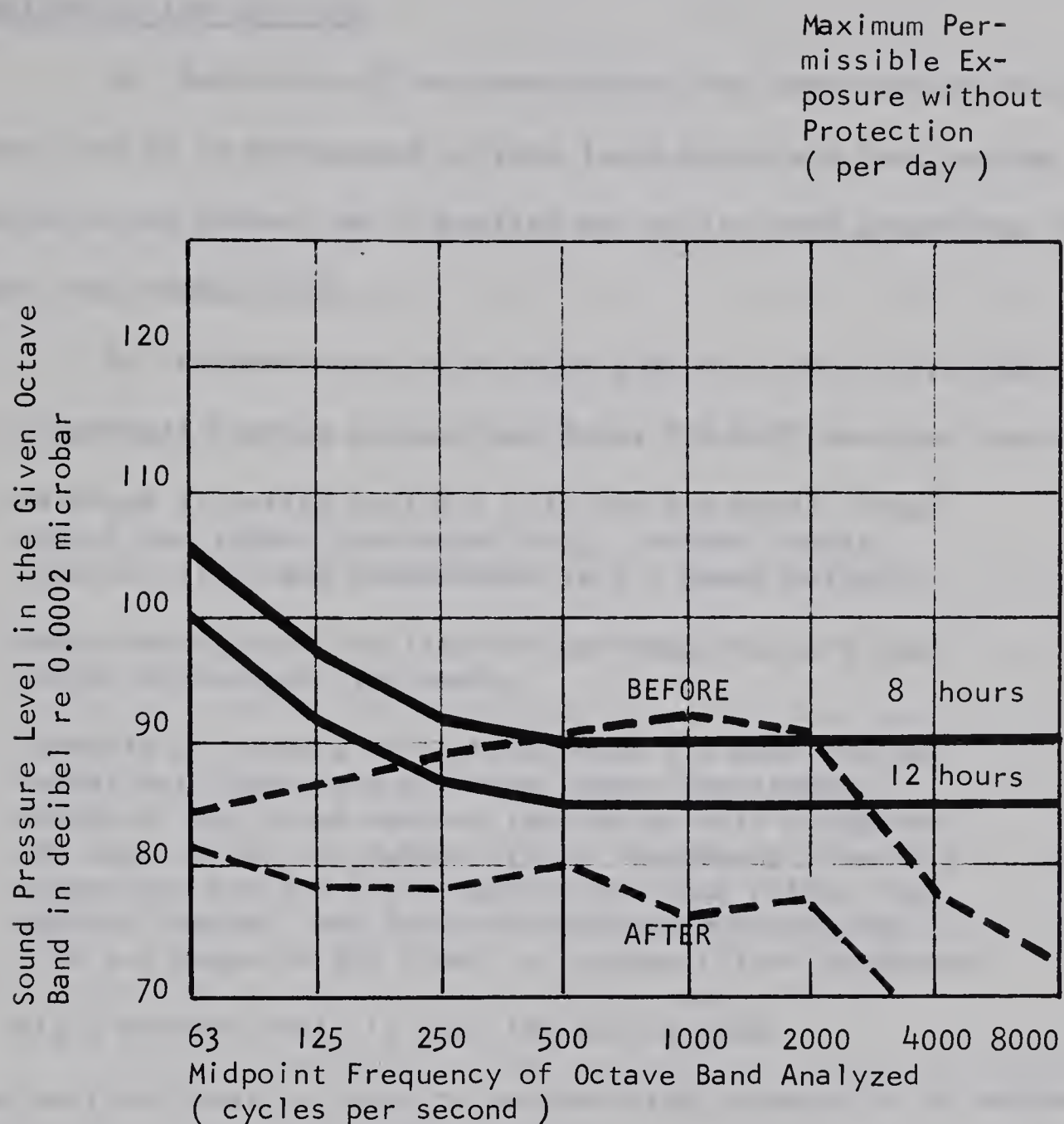
In modern industrial planning, in metallurgy for instance, noise levels often influence the design of a factory, the various departments being arranged according to the intensity of noise they are likely to produce.

The same author gives an example of extensive PONE manipulation.

Some people are always hopeful that a scientific innovation will come along to solve the problem. Physicists for instance, propose one evil to suppress another. As an antidote to noise they suggest using electronic apparatus whose loudspeakers would emit sound waves with oscillations of the same amplitude as that of the unwanted noise but in the inverse phase. The resulting interference, they say, would wipe out the noise.







An example of the manipulation of potential occupational noise exposure. Change of the noise level at a control panel before and after erection of a noise barrier round turbines in the Foothills Hospital power plant at Calgary.

graph 1

An Example of the Manipulation of the Potential Occupational Noise Exposure.





A similar example is the dampening of noise in elevators by use of ventilators.

## 2) Action by the Employee

a) Reduction of the unnecessary time spent around the PONE source. The Ee is encouraged to take lunch hours and rest periods away from the noise source. He is advised not to let work procedures run longer than needed (109).

b) Propose that he be reassigned to a noise free job.

Use of personal hearing protection; Gales (35:477) mentions four types:

Earplugs (inserts) that fit into the ear canal. These are of two types: pre-formed (e.g., molded rubber, plastic, etc.) and unpreformed (e.g., waxed cotton).

Semi-inserts that fit into the ear canal but are supported by headset-type bands.

Earmuffs or sockets or cushions that fit over the external ear. These are of three types: foam-rubber cushions that press against the ear as well as against the head, fiber- or rubber-filled 'doughnuts' that fit around the ear and press against the head rather than against the ear, and fluid-filled doughnuts similar in size and shape to the fiber- or rubber-filled doughnuts.

Rigid helmets that fit over the entire head.

Gales mentions that in order to achieve high attenuation of ambient noise, it is necessary to have a good acoustic seal between the ear protective device and the surfaces against which it bears.

## Education of the Health Provider, of the Employer, and of the Employee

Sataloff (91), Maisel (72), and other authors mention misconceptions about the work condition hazards among employers and employees. Even the knowledge about PONE and OD by health providers such as safety personnel, medical doctors and others, is questionable. These statements go parallel with the question 'How well have these people been



reached in order to change their wrong conceptions?" "Which methods have been used and who have been the educators?" These problems are handled further on.

An underlying educational pattern is that the state health provider, represented by the medical profession, the law enactor, the acoustical consultants and others, instructs the employer associations, the employers themselves, the supervisors on the jobs, the unions, the labor force on the job, the workers as individual persons, the health and safety representatives on the employment, and the general practitioners.

The state health provider is assisted by national government supported study groups such as the Subcommittee on Noise of the American Academy of Ophthalmology and Otolaryngology, the American Industrial Hygiene Association, the Committee on the Problem of Noise in England, etc. There is also support on the international level from the International Association Against Noise in Europe (96), the World Health Organization and the International Labor Office.

The Committee on the Problem of Noise outlines its educational role in the Final Report (20:5):

We therefore consider that an essential step in mitigating the problem of noise is to keep the public informed as to which noise nuisances are readily avoidable and to disseminate existing knowledge more widely to technicians and professional men who deal with noise problems.

#### Modification of the Legislation

The Committee on Pollution of the National Research Council in the United States (19) mentions:

Law and public policy establish the economic, technical, and social environment that determines the response of





private activities ...

The initial impetus to resolve the difficulties inherent in economics, politics and law of the situation can be generated most effectively at the federal level. It is the strong belief of the Committee that priority must be given to initial actions by which the executive branch of government can assume leadership.

An example of strong legal action related to the PONE modification is the California Industrial Safety Board Regulation of January 15, 1963 (63):

Whenever the operations reasonably permit, exposure to excessive noise shall be eliminated or at least reduced by engineering or operational controls and whenever the exposure to noise equals or exceeds 95 decibels in octave bands of 300 cycles through 10,000 cycles, the employer shall provide and the employee shall use acceptable ear protectors (earplugs or earmuffs). The employee shall be informed of the locations where the wearing of ear protectors is required and shall be instructed in the use of such protectors. It shall also be the duty of the employer to provide such ear protectors as may be required and to replace them when it is necessary. It shall be the duty of the employee to properly use such equipment provided for him and exercise due care to keep the same in efficient and sanitary condition.

One is reminded, however, that the institution of tough legislation can paralyze not only the employer but also make workers temporarily or permanently jobless. The degree of PONE mitigation laws has to be carefully considered before enactment. The state health provider is faced with the dilemma of either workers' hearing loss or workers' job loss. The role of the HPr is not only to take the best choice but also to search for better alternatives than tough legislation.

#### 4. Manifestation of Occupational Deafness

The actual occupational noise exposure can still be above the





safety standards for hearing. Occupational deafness starts when the AONE surpasses approximately 85 dB in the 250 cycles per second (cps) to 8,000 cps range for an eight hour daily exposure.

The impact on the mental and social life of the Ee who deafens gradually is the result of auditory deterioration. There are also extra auditory impacts such as annoyance, physiological reactions, speech interference, controversial efficiency loss. The relationship of the process of PONE to the mental and social impact is represented in figure 11.

Why pay attention to the physical, mental and social impact of noise induced hearing loss? One of the essential problems in the prevention of OD is the lack of insight in the severity of the impact of gradual deafening. Not only the Ee and the general public, but also the Er and an unknown number of HPr consider noise as a mere nuisance, not a danger (9:176). Occupational health periodicals, which are educational mass media between the HPr and the industrial population emphasize that noise has to be eliminated on the job. They, however, do not stress the why, and the severity of OD. Audiometric data or extensive dB levels are sterile information for the industrial population. An Er or an Ee cannot evaluate this information. Sataloff (92:340) mentions that it is not enough to know what happens to the ears, but also between the ears. The following sections are a preliminary effort to present the mental and social impact of OD on the worker.

#### a) Importance of Hearing

Although some devices are more accurate than the human response to sound, it is not correct to conclude that hearing fulfills a less important role in human life than before.



According to a study by Ramsdell (23:459), which is now considered as classic by many authors (79:284)(74), hearing functions on three levels.

### The Social or Symbolic Level

At the social level hearing is used to understand language. Words are symbols for objects and activities, for concrete and abstract concepts. For example, the word "drill" means an instrument in the shape of ... to make holes. Since language is symbolic in its nature, this level is called the symbolic level. To receive combinations of sound on the social level is not only important in every day life but also important as a communication means on the job, although in noisy jobs of 90 dB and more a minimum of words may be used.

### Warning or Signal Level

Sound serves as a direct signal of events to which we make constant adjustments in daily living. Myklebust (77) remarks that self-preservation is obvious and shown by a constant readiness of the hearing system. Even while asleep a person can be alarmed by sound. The hearing system is the most appropriate to perceive warning in case of imminent danger or potentially dangerous situations (34:123).

### The Primitive Level

Sound serves as an auditory background for all daily living. The accidental noises maintain the feeling of being part of the living world. We are not conscious of the important role which these background noises play in the comfortable merging of ourselves with the life around us, because we are not aware that we hear them. Stramentov (102) mentions that absolute silence is contrary to nature. Surprisingly noise has the dual character of being both harmful and useful





(79:284)(23:340)(74).

Gales (34:123), Van Wely and Willems (107:113) mention some more qualities of hearing.

The analysis of the components of a sound is possible as well as the distinction between wanted and unwanted sounds. Attention can be focused on typical sounds and the perception of other sounds can be attenuated. This is for instance necessary for motor testing. Ellis and Ludwig (62:72) mention that color in sound can be detected, which means that the sound heard as such will be perceived differently from the sound in a combination of other sounds.

Hearing is important when information is presented independently of the orientation of the head. As Myklebust (77) notes, this is possible because hearing acts non-directionally. Hearing acts as an antenna and scans the environment in all directions simultaneously. We can hear in the dark, through walls, around corners. When a person's duties require him to move about or to turn his head and body in different directions, visual presentation, which is directional, is undesirable, because of the possibility that he might miss important information or be so confined in his movements that he cannot perform his task efficiently.

Many complex tasks such as piloting an aircraft require so much attention to visual indicators that additional displays are undesirable. In such a case auditory presentation can be used to supplement the overloaded visual system.

Hearing is affected less than any other sensory system by fatigue (107:113).

Van Wely and Willems (107:113) note that on the one hand,





the hearing ability is not used enough and, on the other hand, there is too much damaged by noisy processes.

In the light of the occupational benefit, good hearing is important. Ruttle (90) comments:

Most companies are faced with the problem of a so called "aging work force". It is generally accepted in large companies that, with the stabilization of the work force which has developed in the last few years, the problem of making effective use of the older worker have become more prevalent. Effective utilization of these people is dependent, to a large degree, upon the physical and mental suitability for work which is available.

b) The Human Hearing Sensitivity

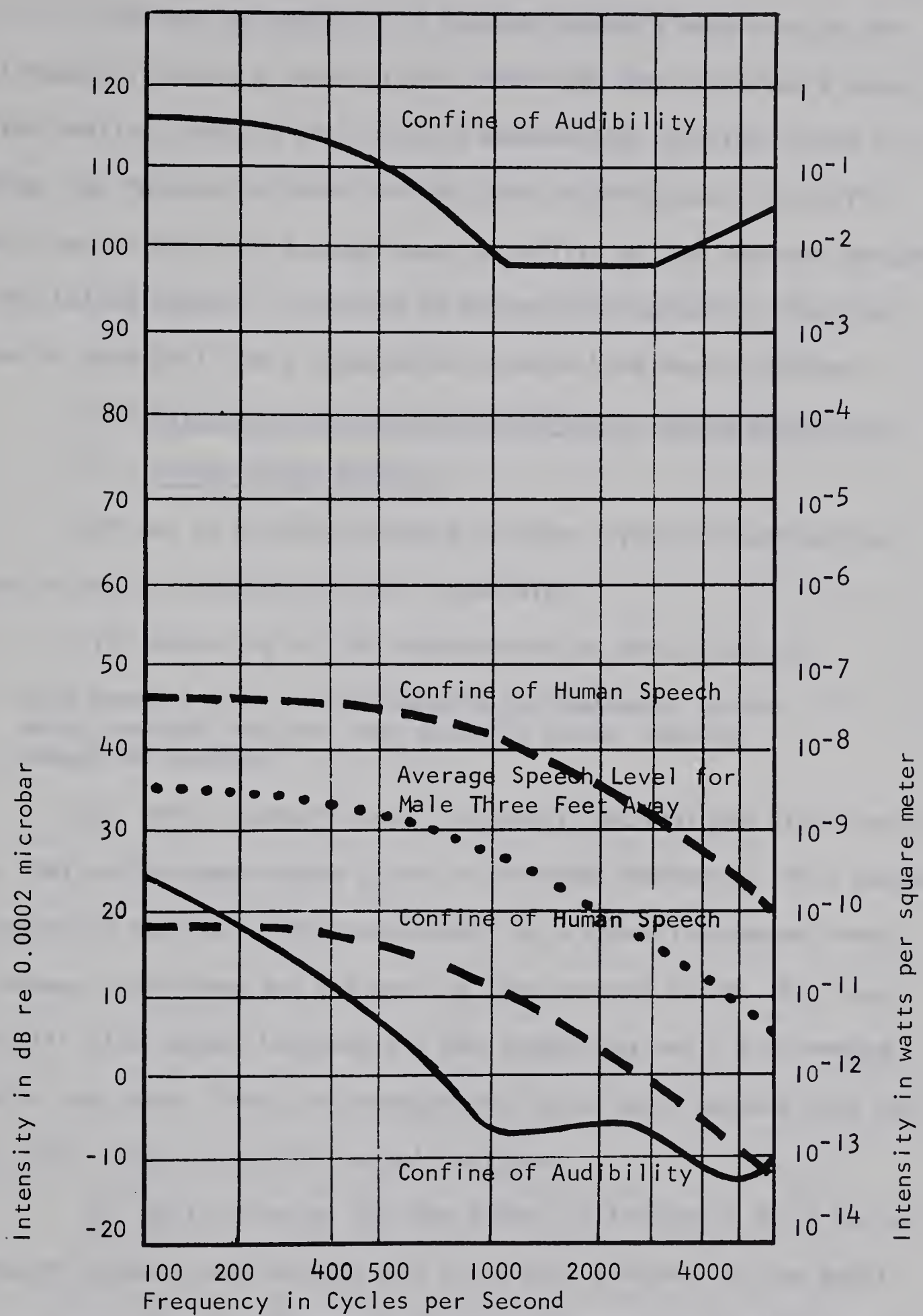
Children and young adults can detect in normal conditions of hearing and silence a frequency range from 15 cycles per second to approximately 15,000 cps (54:314)(2).

The maximum sensitivity range is between 300 cps and 4,000 cps. Beranek (11) mentions that the sensitivity has to be in good condition between 200 cps and 6,000 cps in order to understand English speech well. The vowels of human speech lie below 1,500 cps and the consonants above 1,500 cps.

Concerning intensity, Gales (34:123) mentions a sensitivity range from 0,0001 microbar to 1,000 microbar. There is a sensation of discomfort at 120 dB and pain is felt at approximately 130 dB (103) (89). Confines of audibility and of average speech are set up in graph 11.

Lawrence (5)(58) mentions that human hearing can distinguish plus minus 300 shades of loudness and over 1,500 different pitches. By combining these discriminable steps for intensity and frequency, it is possible to recognize and classify more than 340,000 separate tones.





graph II

Confines of Audibility and Average Speech





The hearing sensitivity changes probably according to the environment in which a person lives. Rosen (9) has conducted a study of the hearing capacity of non-noise exposed and isolated tribes in Africa, the Mabaans in Sudan. He has found hearing acuity significantly better than the average hearing ability of the same age groups in the United States. It can not be stated with certainty that the above is true until more comparative studies have been conducted.

c) Physiopathological and Audiometric Interpretation of Occupational Deafness

OD can be differentiated from other types of deafness because of specific characteristics. Some are:

1) According to the Subcommittee on Noise (103:4):

This hearing loss is not amenable to treatment; once a noise induced loss has been acquired normal hearing cannot be restored ...

2) OD is sensori-neural. Sataloff (92:177) and others mention that early damage takes place in the outer haircells. This stage is sensorial deafness with recruitment as a specific symptom. When the damage progresses and the hearing loss exceeds 50 dB, the inner haircells also become involved and the supporting cells are damaged. Finally the nerve fibers are damaged and recruitment becomes less evident. This stage is sensori-neural deafness.

3) OD is binaural but the amount of threshold shift can be different between the left and the right ear. Contrary to the public opinion, noise does not damage the eardrum, except for explosion type air vibration, where not only the eardrum is disrupted but also the ossicular chain can be dislocated (107:113).

4) Sudden unrecoverable deafness is not caused by contin-





uous exposure to occupational noise except for explosions.

5) There is no interaction between the age- and noise-effect, which implies that both are additive. In other words, it is not because of increasing noise exposure that presbycusis will increase too, and vice-versa.

6) Hearing loss first appears between 3,000 and 6,000 cps with the greatest loss at the 4,000 cps also called the  $C_5$  dip, even for low frequency noises (33:288). Thresholds below 3,000 cps in the early stages remain quasi normal. Sataloff (92:175), however, cites some exceptional examples of hearing damage in the 1,000 cps to 2,000 cps range. See graph III. Knight (98:723) comments on such information that people with a loss at the 2,000 cps range and below have a greater social handicap initially than persons with deafness in the higher frequencies. Knight (98:717) mentions:

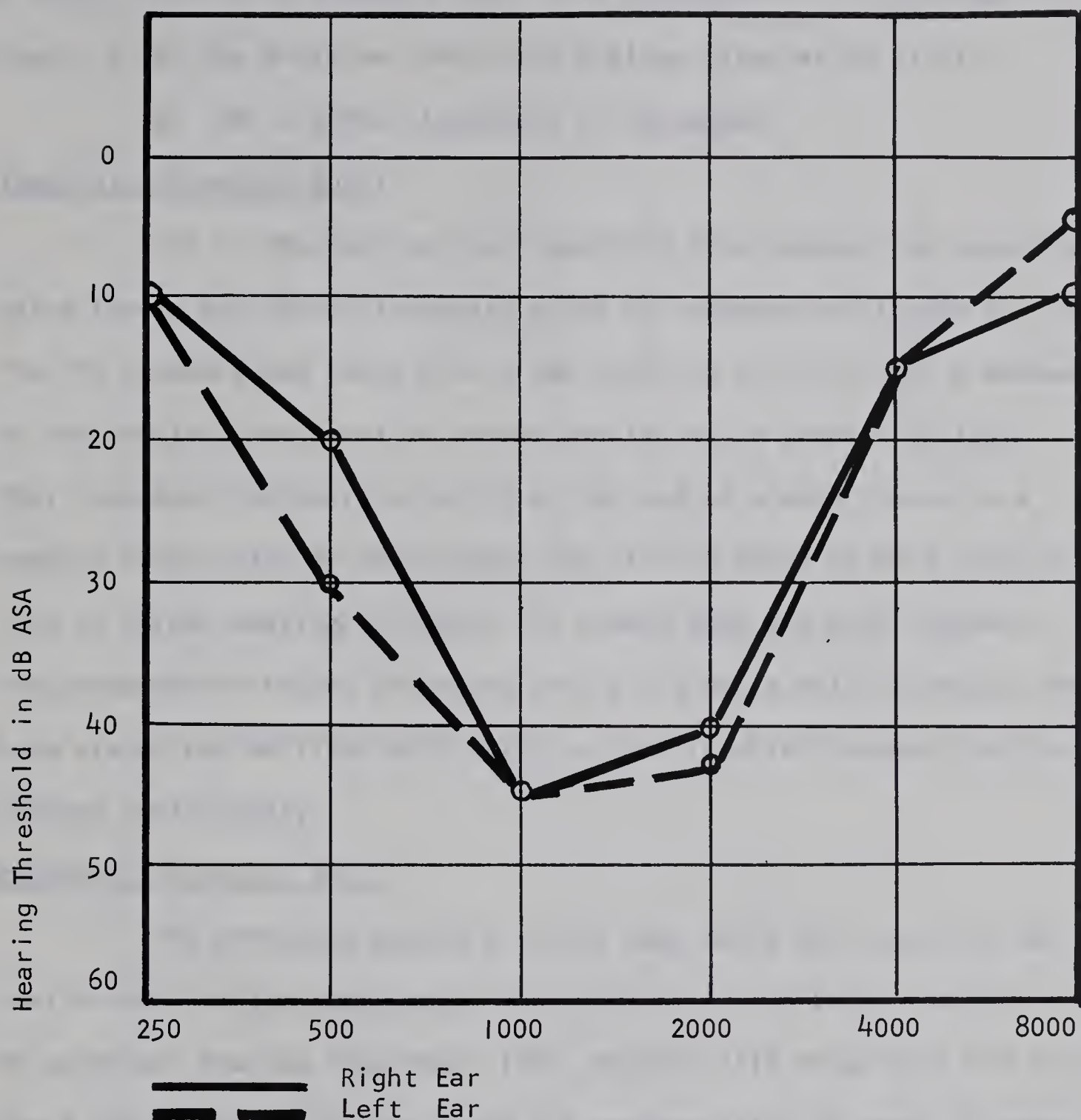
Jet aircraft noise, which has a continuous spectrum and an overall noise level of 149 dB, causes deafness of considerable degree, and at the lower frequency level of 2,000 cps and under.

The  $C_5$  dip broadens gradually in the lower octave bands and so affects the speech frequencies, first the consonants, later the vowels. The octave band above the 4,000 cps is less affected by OD than by prebycusis. Compensation boards have refused in the past to pay out claims on ground of insufficient proof of OD, instead of deafness by aging.

7) The low octave bands, i.e., under the 300 cps require more intensity noises to produce a significant hearing loss (91).

8) The susceptibility to OD in a population corresponds to a normal frequency distribution (33:288)(111)(40). The weaker ears quickly develop a profound audiometric dip while the tougher ears need





History: Forty eight year old male employed in large mill with high noise levels. The noise spectrum is such that speech frequencies are affected more than the higher frequencies. Fellow employees have similar losses.

Classification: Bilateral sensory impairment.

Diagnosis: Noise induced hearing loss  
Some evidence of recruitment.

graph III

Audiogram of the Audibility in the 1000 and 2000 Cycles per Second Frequency Range of an Employee with Occupational Deafness.





a longer time to be affected (10). This phenomenon is illustrated in graph IV, by the American Industrial Hygiene Association (3:51).

9) OD is either temporary or permanent.

#### Temporary Threshold Shift

TTS is the hearing loss resulting from exposure to excessive noise levels and which disappears after an undetermined length of time. The TTS recovery can range from a few hours to a full night, a weekend, or even months. Recuperation curves are set up in graph V (9:159). They represent the hearing acuity at the end of a week's work in a weaving shop, after 60 hours rest, and after 8 hours of work. The return to normal hearing is longer for middle aged and older workers. The compensation boards therefore want a six month waiting period, before claims can be filed definitely, a time in which recovery can be checked sufficiently.

#### Permanent Threshold Shift

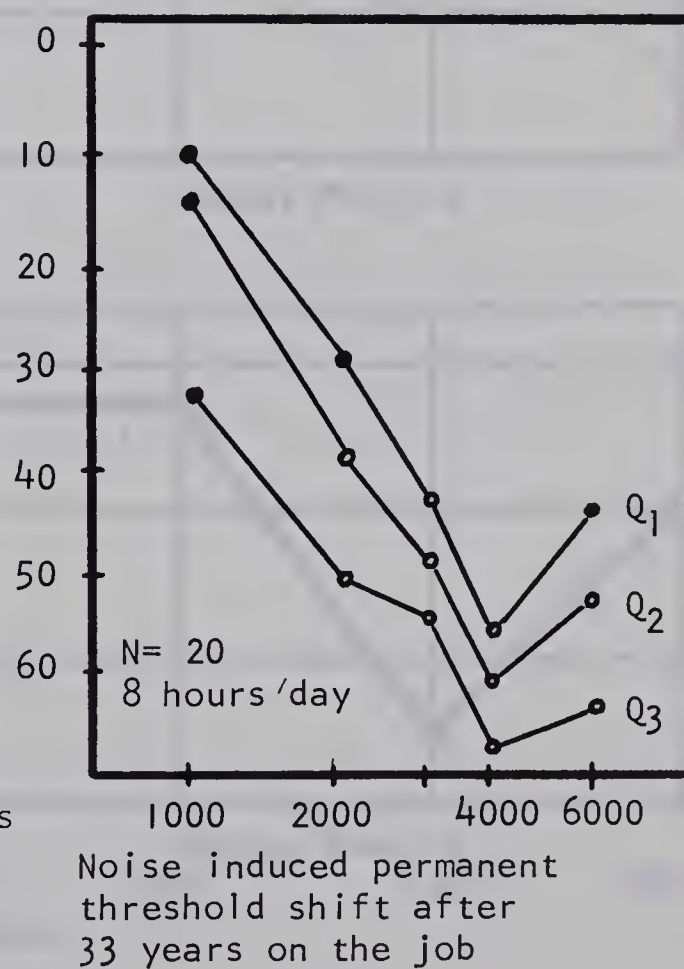
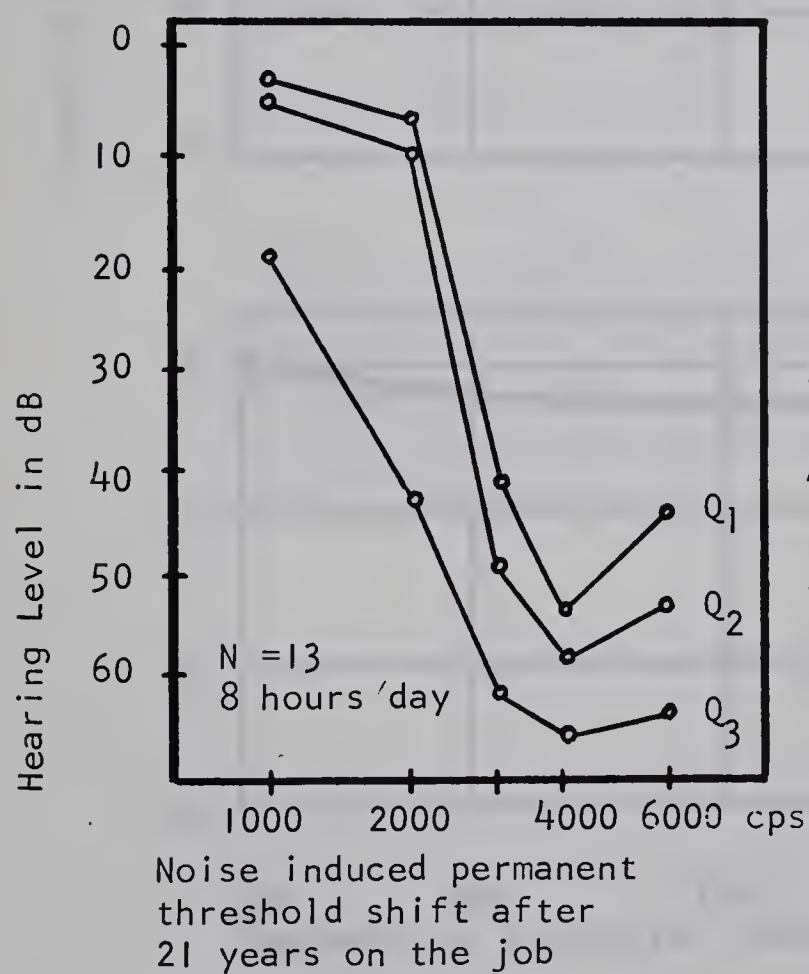
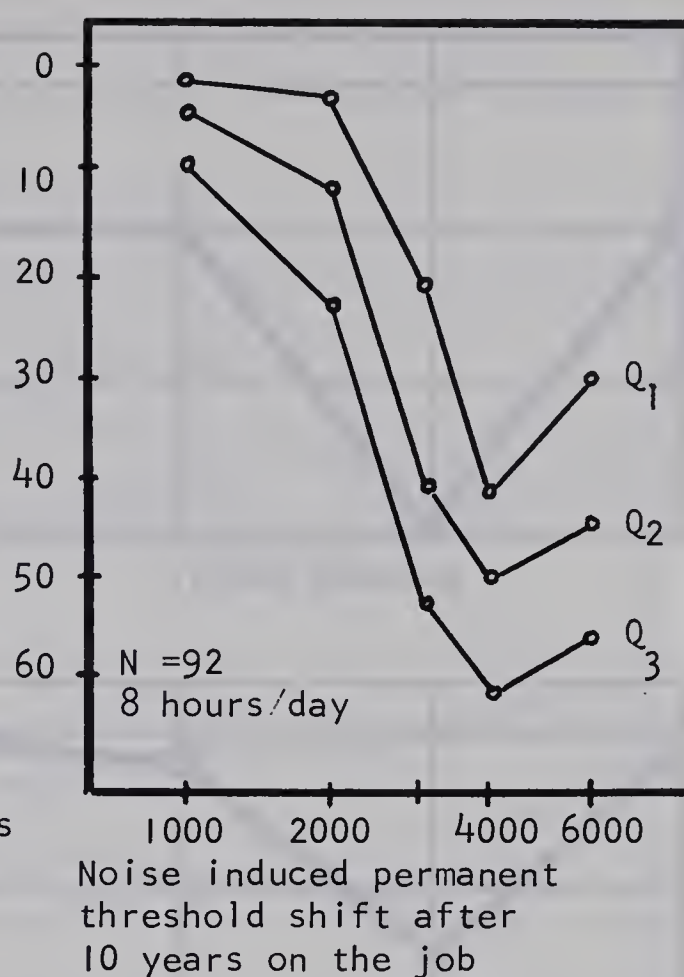
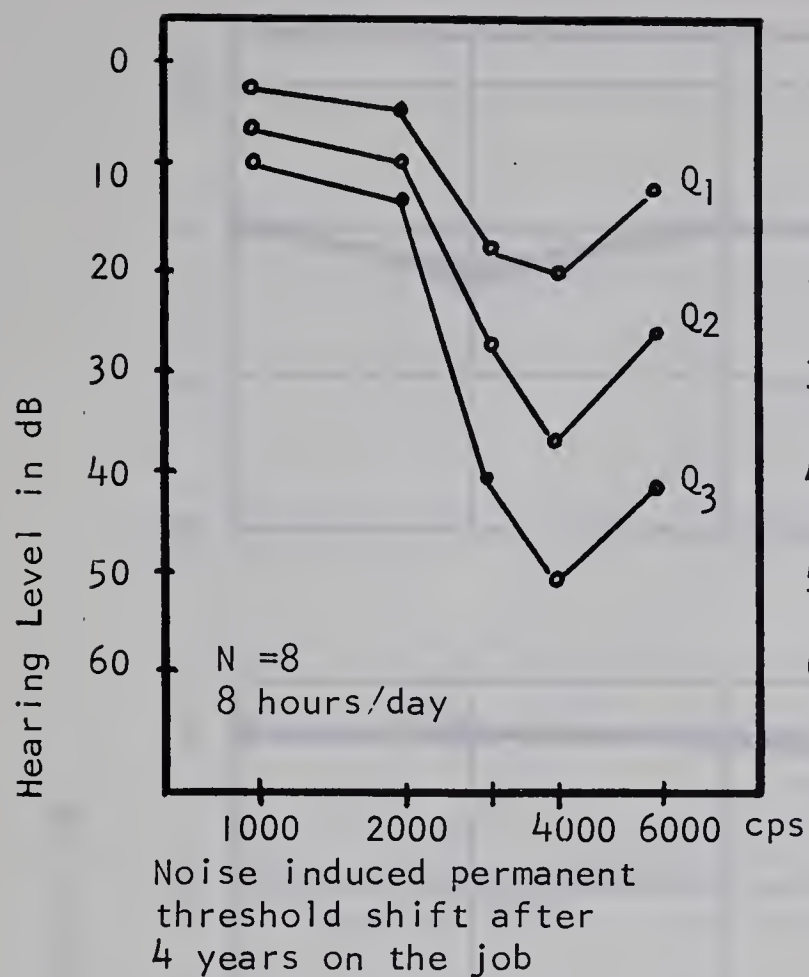
The prolonged exposure to the same noise can result in partial recovery after some years, the residual losses being indicative of permanent hearing impairment (26). Beranek (11) notes that PTS for the 3,000 and 4,000 cps can reach its maximum after 15 years of exposure to excessive noise of an over-all intensity of 90 dB. Further losses at these frequencies appear to be accounted for by the aging process. Loss of hearing at frequencies of 2,000 cps and below does not reach a maximum until after 30 years of exposure. See graph VI.

#### Temporary and Permanent Threshold Relationship

A noise that does not cause TTS will not cause PTS. Gafafer (33:290), Beales (9), Bell (10), note that TTS and PTS run parallel on their different time scales. For example, the TTS for a given noise of



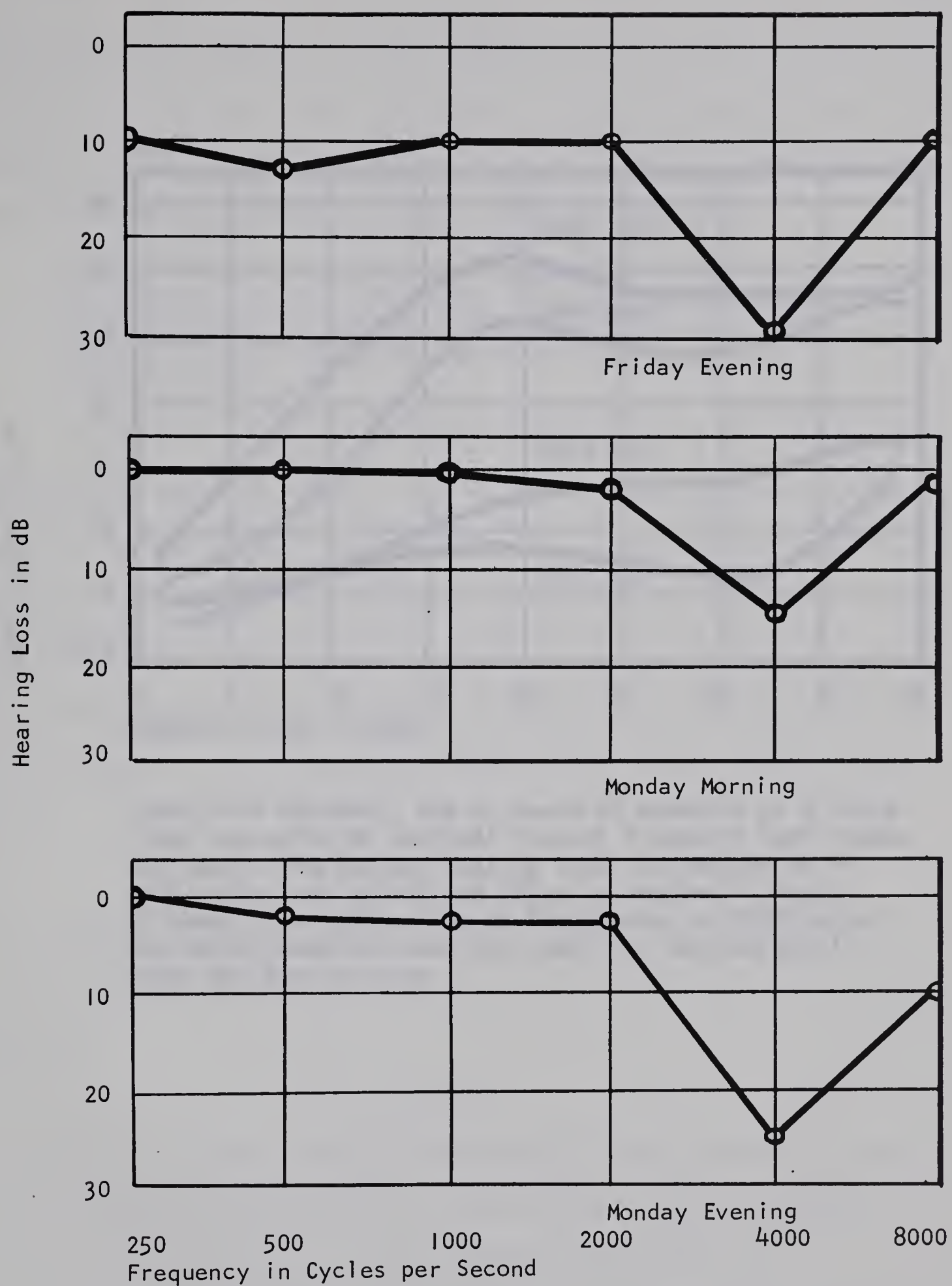




graph IV

Comparative Evolution of Permanent Threshold Shift between Sensitive and Non-sensitive Ears for Continuous Exposure to Potential Occupational Noise of Eight Hours per Day.



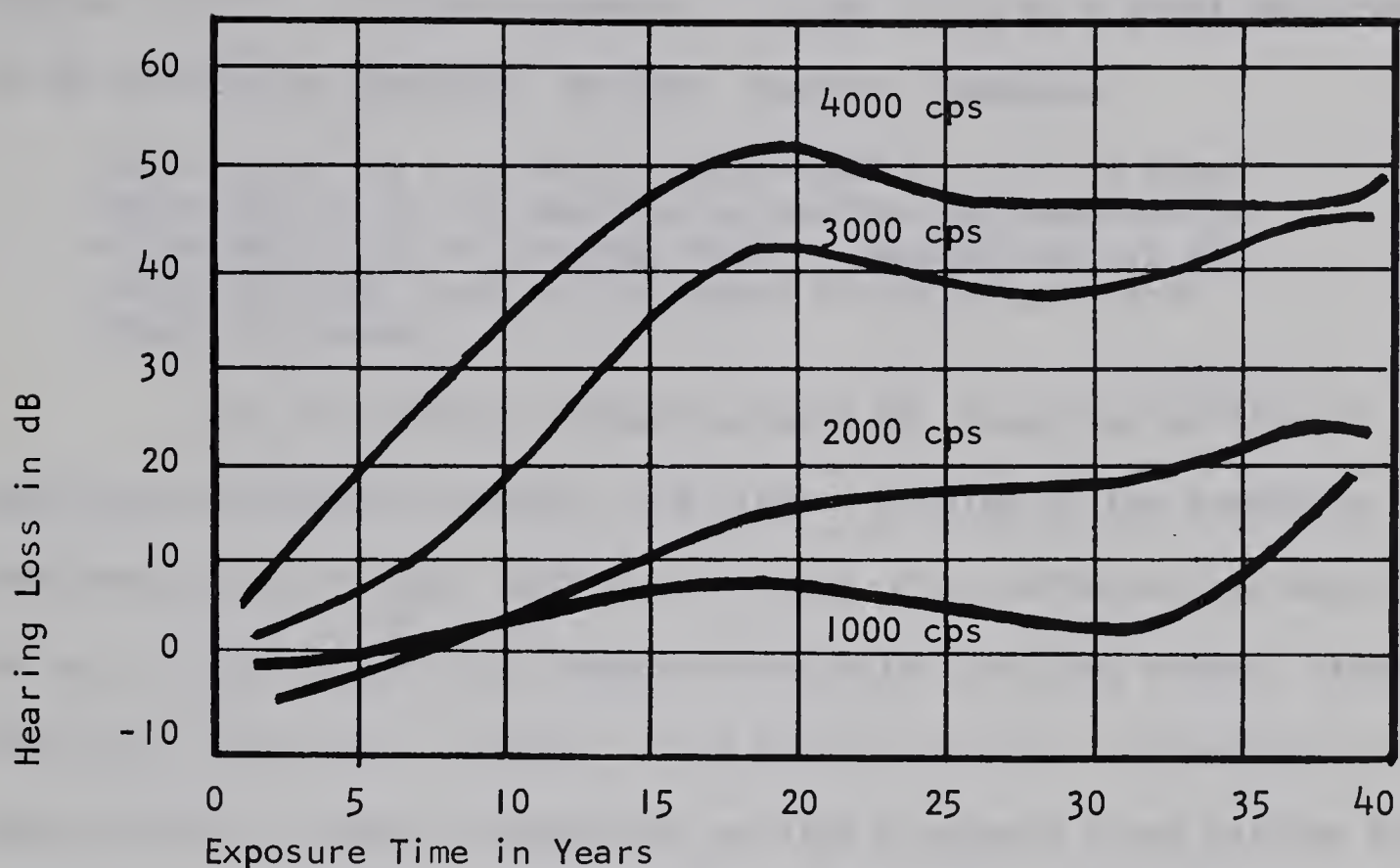


graph V

Audiometric Curves with Changes in the Hearing of Weavers after Sixty Hours of Rest and Eight Hours of Work. (9:159).







Cumulative deafness, due to years of exposure to a noise level averaging 90 decibels in each frequency band, shows two peaks. The maximum hearing loss at frequencies of 3000 cycles per second and above is reached in about 15 years. Loss of hearing at frequencies of 2000 cycles and below, however, does not reach its maximum until after 30 years or more.

graph VI

Hearing Loss in the Speech Frequencies and the Higher Frequencies for Exposure to Noise of Ninety Decibels.



eight hour daily exposure closely parallels the PTS after 10 years of exposure to the same noise. A possibility exists of predicting to some degree the PTS. If this phenomenon is true, it is of a great advantage to OD prevention. Sataloff (92:178), however, comments:

There is as yet no proof of relationship ... It is also known that it is not possible to predict the sensitivity of an individual to intense noise by determining his TTS characteristic, such as its degree or rapidity of its return to normal.

10) The worker, threatened with OD, loses the ability to understand consonants clearly. The biggest problem of the gradually deafened is not to hear, but to understand or to differentiate words or parts of them (92:177). Dougherty and Welsh (26) and others, stress the point that much of speech is low frequency sound, whereas the understanding of speech is dependent on high frequency sound carried by the consonants. The first sounds to be lost are the fricative consonants:

F, S, TH, CH, SH,

for example, words sick, thick, flick or chick, are difficult to differentiate. As the impairment progresses, the explosive consonants such as

B, T, K, P, D,

become hard to differentiate. An insight into the progressive impairment of moderate and severe OD is represented through an example, worked out by Dougherty and Welsh (5)(26). See table III.

Background noise blocks the high frequency sounds, which are already difficult to differentiate in non-noise conditions. Speaking louder will be more disturbing because the intensity of the consonants as well as the vowels is raised. The vowels become annoying. The



T H E F I R S T S O U N D S

L O S T A R E T H E

F R I C A T I V E C O N S O N A N T S

normal hearing

E I R T O U N D

L O T A R E E

R I C A T I V E C O N O N A N T

fricative consonants

moderate loss

E I R O U N

L O A R E E

R I A I V E O N O N A N

explosive consonants

severe loss

table III

An Example of the Loss of Fricative and Explosive Consonants According to the Degree of Hearing Loss.





deafened person will only want to enunciate more clearly. Because of the consonant deformation, the OD affected worker will also have difficulty in understanding voices reproduced through amplifiers like in radios, TV, and telephone (92:334).

A classification of hearing loss, containing the degree of hearing loss, the dB loss and the speech communication difficulty, is set up by Glorig (10). See table IV.

d) Mental and Social Impact of Occupational Deafness

The mental and social implications are difficult to separate because of the continuous interaction. Mental disturbance results in social rejection, which again influences the mental life of the affected Ee. OD is a self-societal problem with a continuous auditory impact and the mental-social impact are schematically represented in figure 11. The HPr, the Er, the Ee, all have a decision to make in the prevention of OD. Insight into the underlying reasons for OD prevention is important.

The Evolution of the Occupational Deafness

O'Neill (80:35) mentions a few characteristics associated with gradual hearing loss. These elements however are not exclusive for OD only.

- Lack of attention to casual conversation.
- Frequent requests to repeat what has been said.
- Frequent ear aches and complaints of ear difficulties.
- Tendency to be withdrawn and lack of desire to be involved in social activities.
- Difficulty in articulating certain speech sounds.
- Frequent confusion as to what has been said.
- Constant visual scanning of the speaker's face.

The deafening Ee enters a stage of insecurity because he misses key words in conversation. He attributes the bad understandings



Class	Degree	Average decibel loss at 500, 1,000, 2,000 Hz in better ear	Remarks
I	Normal	Less than 15 dB	Within normal limits
II	Near normal	15 - 25 dB	No difficulty with ordinary conversation at distances up to 20 ft (6 m)
III	Mild loss	25 - 40 dB	Difficulty with ordinary conversation when distance exceeds 5 ft (1,5 m)
IV	Moderate loss	40 - 65 dB	Difficulty with loud conversation when distance exceeds 5 ft (1,5 m)
V	Severe loss	65 - 75 dB	Difficulty with shout when distance exceeds 5 ft (1,5m)
VI	Profound loss	75 - 85 dB	Difficulty with shout at less than 5 ft (1,5 m)
VII	Practically total loss	More than 85 dB	Loss of practical hearing for speech

table IV

Classification of Hearing Loss According to the Degree of the Impact, the Decibel Loss, and the Difficulty of Understanding Speech.





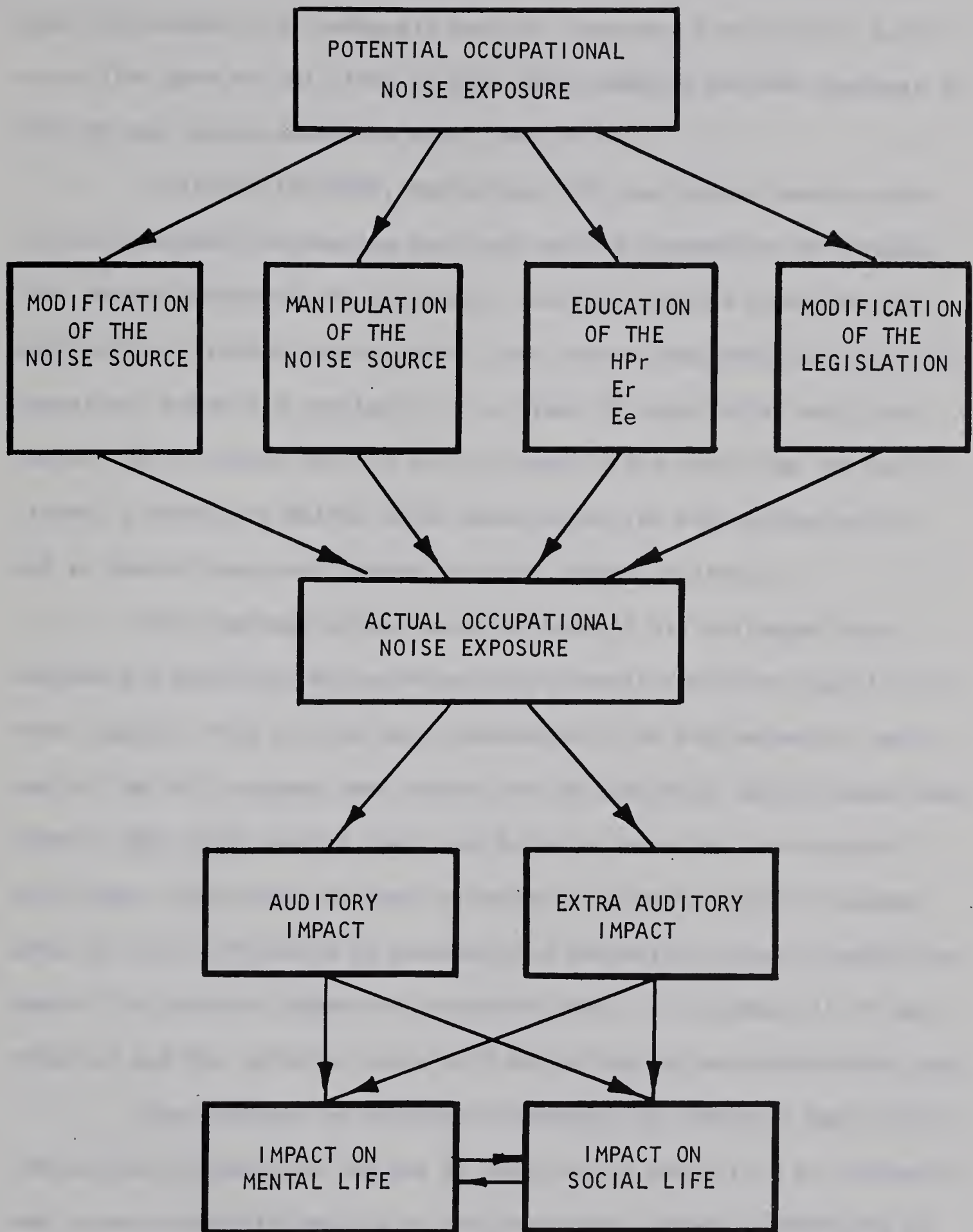


figure II

Relation of the Potential Occupational Noise Exposure to the Impact on the Mental and Social Life of the Exposed Worker.



to casual tiredness or worries which occupy him. In the beginning he does not suspect his inadequate hearing. However, frustrations build up as time goes on. His lack of good understanding becomes apparent to him. He may become desperate about what to do.

Sataloff (92:344), Ballantyne (7), and others mention that so called borderline hearing loss may lay the foundation for changes in a person's personality structure. The fact that he sometimes understands everything and at other times misses important parts of conversation, keeps him constantly in a state of uncertainty and insecurity. He is afraid that he may not make it the next time. He has to listen, a voluntary action which means attention and concentration, and so there is an ever present varying degree of strain.

The deafened worker wants to know if his colleagues have noticed his handicap. He therefore suspiciously scans the reaction of other people. This will be more pronounced if he has paranoiac tendencies. He will suspect that others are deliberately talking about him. O'Neill (80: 104) remarks that such behavior develops an uncertain self-image. The worker becomes ambivalent. He may attempt to compensate for this difficulty by developing a dominating, overly verbal behavior. He operates under the assumption that, if he does all of the ordering and the talking, there will be no fear of what others may say.

The deafened Ee may have a tendency to ignore or deny first indications of deafness. He has an aversion to consulting an otologist and resents that his hearing is not quite good (92:243). When the OD becomes worse, the affected worker does not answer question or hear remarks. Fellow workers may start to ridicule him, although they are not aware of the poor man's handicap. This leads to the desire to es-





cape from communicative circumstances. The Ee may assume passivity, inhibition and rejection.

Levine (60) mentions that the deafened may consciously or unconsciously narrow his field of operation and expression to a zone of acoustical security. The problem of the progressively deafened is to make continuous adjustments and readjustments to each new acoustic environment created by his changing pattern of hearing. According to Oyer (81:13), he must unlearn some of the old responses and learn new ones. A transitional period can have disquietening effects not only because habit patterns are firmly fixed, but also because the human organism tends to resist change of habit.

Myklebust (77) mentions that deprivation limits the world of experience. It deprives the individual of some of the material resources from which the mind develops. Because total experience is reduced, because reality is perceived less affectively, there is an imposition on the balance and equilibrium of all psychological processes. When one type of sensory information is lacking, it alters the integration and function of all the others. Myklebust further mentions that the most clearly defined mental functions which have been shown to be modified by deafness are memory and conceptualization. It seems that to remember experiences which are auditory, or readily lend themselves to making auditory associations, is more difficult when experience must be perceived through vision.

Levine (60) mentions some problems in severe deafness:

Together with the feeling of being detached, a confusing distortion in audio-visual "Gestalt" arises from sensorially illogical difference between the auditory estimate of the distance of sound and the actual visible evidence of its source.





While the sufferer is engulfed in the struggle to bring the incredible distorted body of sound into some semblance of perceptive order, he is threatened by another type of auditory problem, namely, decreased ability to gauge and to monitor sounds of his own voice. As time goes on defective enunciation makes it more difficult for the listener to understand a voice which becomes rigid and monotonous.

According to Ramsdell (79:283), Menzel (74), and other authors, handicapped people have a natural aversion to advertise their problem. The hard of hearing individual manifests this tendency to a great extent because he has no visible evidence of his handicap. In other words, his ears look just the same as all normal hearing ears. Hoegger (47) also notes that workers have the tendency to hide their hearing loss. The OD affected Ee is reluctant to wear a hearing aid, except where he is driven to it by despair and he will accept it when he is ascertained of maximal concealment.

It is a fundamental principle of mental health that a person with a handicap should not attempt to conceal it (79:283)(74). The person hiding a disability is continuously under tension for fear that his secret will become known to others. The advertising of hearing aids is based on maximum concealment, while glasses are presented as making one good looking. How can a person truly master his problem, when the foundation of it is based on fear? This may result in a stigma. As long as deafness goes unnoticed, the greater are the frustrations.

Levine, Welles and Zucker (60:61), note some characteristics of the hard of hearing.

Significantly more emotional,  
Significantly more introverted,  
Less dominant than the average of their hearing friends,  
Persistent pattern of submissiveness,



Resignation,  
 Suppressed hostility,  
 Anxiety,  
 Depression,  
 Fear of failure, ridicule, new situations and of  
 being avoided.

### Some Social Impacts on the Deafened Worker

Because his self-existence is the answer to the challenging surroundings, every human being is continuously, consciously or unconsciously, expecting stimuli from his environment with which to react. The only medium in which man's mind can function satisfactorily is the herd, which therefore is not only the source of his opinions, his credulities, his disbelief and weakness, but of his altruism, his charity, his enthusiasm and his power (7:222).

O'Neill (80:107) clarifies the evolution of the self-concept of the hard of hearing.

The individual always seeks to satisfy his needs by manipulating his environment. He is always seeking some goal because he needs to maintain and build up his phenomenal self. These goals are aimed at getting others to accept his self-image. In fact his every day behavior will be directed towards the shaping of his environment, his own behavior, and the behavior of others so that he can attain re-inforcement of his self-image. What emerges is a pattern of behavior which is pertinent to the attainment of the individual's goals. Add to this a lack of a symbol system to communicate his feelings, needs, and desires, and it is obvious that he will have a deviant pattern of behavior.

According to Sataloff (91), Ramsdell (23), Levine (60), and others, the most obvious handicap is the lack of communication and many problems of the deafening Ee stem from the limitation in social intercourse. The Ee has grown up in a speaking society and he knows of no other. This is his natural habitat, while to the deaf by birth the natural habitat is the world of silence.







The deafened Ee seeks feedback, engaging in reality testing, but his lack of audition makes it difficult to interchange ideas with others. The deafness limits the ability to sense the feelings, ideas, criticisms and the demeanor of others and hence restricts comparison with one self, according to Myklebust (77).

According to Ballantyne (7), Ramsdell (23), the deafened person cannot identify himself with the interests of the speaking community and his participation in feelings and observations of others is restricted to those who address him deliberately.

Increasing deafness develops dependency on society, it can be on fellow workers, family, strangers, or even the taxpayer because of reorientation vocational training. The repeated need of attention from others may result in disdain of society, an attitude of aloofness, disengagement and isolation.

However, obligations to the society persist and the afflicted Ee has to confront situations in which he will experience dependency, suspicion, and help. His ambition may suffer and often he has to resign responsibilities and has to assume a position less worthy of his potential (92:342).

The evaluation of the self, in a large measure is affected by an individual's perception of himself by others. Total lack of concern by others can affect adversely one's self adjustment pattern and thereby materially affect one's self-concept, according to Oyer (81:20).

Although wage is generally accepted as an important incentive to work, the threatened Ee is not only moved by financial loss, but he is afraid to lose admiration from fellow workers, status, and



the safe feeling provided in the informal primary group. He has to withdraw from situations of which he has been an integral part.

Sataloff (92) mentions:

The strength of the individual and his mental, spiritual and economic resources to triumph over adversity are determining how a deafened person will cope with gradual hearing impairment.



## CHAPTER III

### DEVELOPMENT OF THE INVESTIGATION STRUCTURE

#### 1. The Employer - Employee Relationship and the Potential Occupational Noise Exposure

Employment exists basically of two populations, i.e., the employer and the employee, except in the case of the self-employed employer, such as the truckdriver-owner. The existence of both partners is determined by the mutual interest in the employment. As soon as one of them disappears, so does the other. When there is no laborforce, the management takes the role of possessor or responsible caretaker, but no longer as employer.

According to Herzberg (44:28) (45), the following are a number of "Motivation to Work Factors" with impact on the Ee.

##### Job content

- Achievement of the task
- Recognition for the task achievement
- Work itself
- Responsibility for the task
- Professional Growth

##### Job context

- Company policy and administration
- Supervision (technical)
- Relationship with the supervisor
- Work condition
- Salary
- Personal life of the Ee
- Relationship with subordinates
- Status
- Security





The Er is closely involved with the Ee, on basis of most of these factors. One of these elements is not likely to greatly change the Er-Ee understanding except in the case of a relationship which is already near the breaking point.

One is reminded that PONE is a work condition to which workers adapt in a short time. The evolution of PONE on the Er-Ee relationship basis is subject to two possibilities:

a) If PONE is a powerful enough factor, one can expect a rise of complaints and claims filed, related to the noise increase on the job. The Er-Ee relationship is probably not yet saturated with noise and OD complaints.

b) If PONE cannot throw the Er-Ee relationship off balance, it is not likely that there will be a change in the reduction of PONE on the basis of the Er-Ee relationship.

The health provider has to obtain information of the PONE evaluation from both the Er and the Ee, because occupational health education methods depend upon it. The management labor force climate and the PONE occurrence in each particular industrial set has to be studied as an entity.

Mayo (73:12) mentions:

The behavior of workers cannot be studied fruitfully apart from the behavior of management; one affects the other and is affected by the other; they are mutually interdependent.

What is the Er involvement in the PONE occurrence?

The Er appoints people to work procedures and uses their energy in any desired form, either muscular or intellectual, and he compensates the effort with financial and other benefits. However, he



does not have the right to affect the worker's health, because this violates human rights and develops dependency upon the society.

Obligations in order to protect the Ee health are not always respected neither willingly nor unwillingly by both management and the labor force.

The Er uses the workprocedure like a drug, i.e., he knows precisely what the machines are made for and what is their expected output. The manufacturer informs him about this. Where the pharmaceutical plant has to study the side effects of the drug and to make them known, the manufacturer is not bound to study the side effects of machinery dangerous to employees, apart from obvious safety measures, and he obviously does not advertise them too. The employer has to find out for himself from experience at his own expense and that of his employees.

Which is the Ee involvement in the PONE presence? Generally the Ee does not know his audiometric acuity at the time of employment, except in the case of pre-employment testing or in the case of perceived bad hearing. Neither does he know the deleterious effects of PONE on future jobs. However, if he knows both the elements, he is given the choice, either to accept or to refuse the job. Landsberger (57) mentions:

The applicant weighs the subjective desirability of a job against his self-assessed chances of obtaining it and of doing well in it, and balances it against costs and alternatives.

How many workers do realize that they have not the right to expose their health to potential damage as it results in dependency on family, fellow workers, and taxpayers? Of course, they can always





leave the employment, what they are likely to do, when they cannot stand the noise. However, when they are vocationally trained for a mechanical job, they will find fewer noise free jobs, simply because PONE rises in all occupations. The workers are subject to a social problem of a dual nature:

a) To leave the job which is noisy and probably have to accept a job less worthy than their training potential.

b) To accept the noise levels and probably end up with hearing loss, and mental and social troubles as well.

## 2. The Health Provider Involvement

Management and labor force have to know the hazards of their employment in order to safeguard their health and their material and financial benefits. Both have the obligation to look for the best prevention possible. However, they are not compelled to have the technological know-how to investigate and to change chemical and physical hazards to meet safety standards. The solution for them is to obtain valid advice from specialists within the employment. This may be a financial impossibility to many employers. Therefore, information has to be available from outside specialists. The latter can be people appointed through the government or private initiatives.

Some of the specialists are: medical staff, safety engineers, industrial hygienists, government factory inspectors, insurance carriers, safety suppliers, lawyers, government occupational health services, the board of industrial relations, the workmen's compensation boards in their preventive role, and others. These specialists have a



common characteristic, i.e., the protection of human health on the employment. They provide health advice and means to protect the health of the labor force.

The health provider is the person or group of individuals who contribute to the safeguard of the workers' health. In an abstract sense, the HPr is the concept of action through theoretical, technical and legal means to protect the worker and to prevent ill health caused by the employment. The term health provider can be compared to the government concept, which reflects the governing and the people who govern. The medical body is usually largely involved in the HPr function. Also the acoustician is a member of the team which contributes towards PONE reduction. The problem of overall responsibility is handled in the following chapter. The reduction of an occupational hazard is not, and should not be, exclusively the work of the medical authorities. This has been proven in the past.

Dubos (27:28) states:

The most effective techniques to avoid disease came out of the attempts to correct by social measures the injustices and the ugliness brought about by industrialization ...

The huge populations suddenly crowded into the factories and tenements of the mushrooming cities lived in squalor and were exposed to great physical and emotional hardships. Their privations and physiological misery created everywhere social and health problems so acute that they became an obsession for the European conscience. As a result, reform movements started all over the Western world almost spontaneously and simultaneously, and their momentum increased during the second half of the nineteenth century.

Clearly, modern medical science has helped to clean up the mess created by urban and industrial civilization. However, by the time laboratory medicine came effectively into the picture the job had been carried far toward completion by the humanitarians and social reformers of the nineteenth century.





Knowledge of an occupational health hazard is not to be limited to the medical and the technological causality, but has to be expanded to all who deal with the human being as an individual and as a social member.

Mueller (76) mentions:

Health problems of the future, meaning health in its broadest sense, are as much social, economic and managerial problems as they are medical.

### 3. The Health Provider - Employer - Employee Interaction

The occurrence of occupational deafness lies in the attitudes and actions of the people who

- a) develop and maintain the noise hazard, i.e., the employer,
- b) undergo the hazard, i.e., the employee,
- c) mitigate or prevent the hazard, i.e., the health provider.

The involvement of the HPr, the Er, and the Ee, have been outlined in the previous sections. They do not function on separated level and their interaction is a basic factor of PONE and OD reduction. Many proposals for cooperation have been brought forward at conventions and in the occupational health literature. A few examples are:

The American Industrial Hygiene Association (3:155) states:

Because the noise problem has an economic as well as a humanitarian aspect, measures must be found to control and to prevent hearing loss through the cooperative efforts of management, labor, medical, industrial hygiene, legal, safety and research talent.





The Subcommittee on Noise (103:8) states:

The success of hearing conservation depends on the complete cooperation of the employer, the employee and others, concerned with the health and safety of employees. All groups stand to benefit equally from a hearing conservation program, and all groups should give the program their active support.

A basic interaction in the form of a triangular model is suggested in which the HPr, the Er, and the Ee represent a pole. There is a two-way communication between two poles. Each pole is to be contacted by the two other poles and vice-versa. See figure III. The interaction between the HPr, the Er and the Ee is so evident that the Institute for Social Research, University of Michigan (50:128) mentions:

The health service does not exist in a vacuum. It exists in an establishment which is primarily composed of the management and the employees ...

The inter-relations of these three parts are extremely complex. Each of the parts must react to the other parts, to itself, and to the relations between the various parts.

The interaction and hence the triangular model has always existed, even in the case where there is no health service physically present on an employment. The health provider concept, i.e., the urge to prevent industrial health hazards, exists as soon and as long as there are employers, workers, and hazards on the job. Research into the interaction within the HPr-Er-Ee set has been delayed by the HPr. The need to settle damage risk criteria, standard unification, protective legislation, presbycusis compensation and other problems probably seems to be more urgent.

Although the three poles are schematically represented by three equal circles, this does not mean that each group has the same



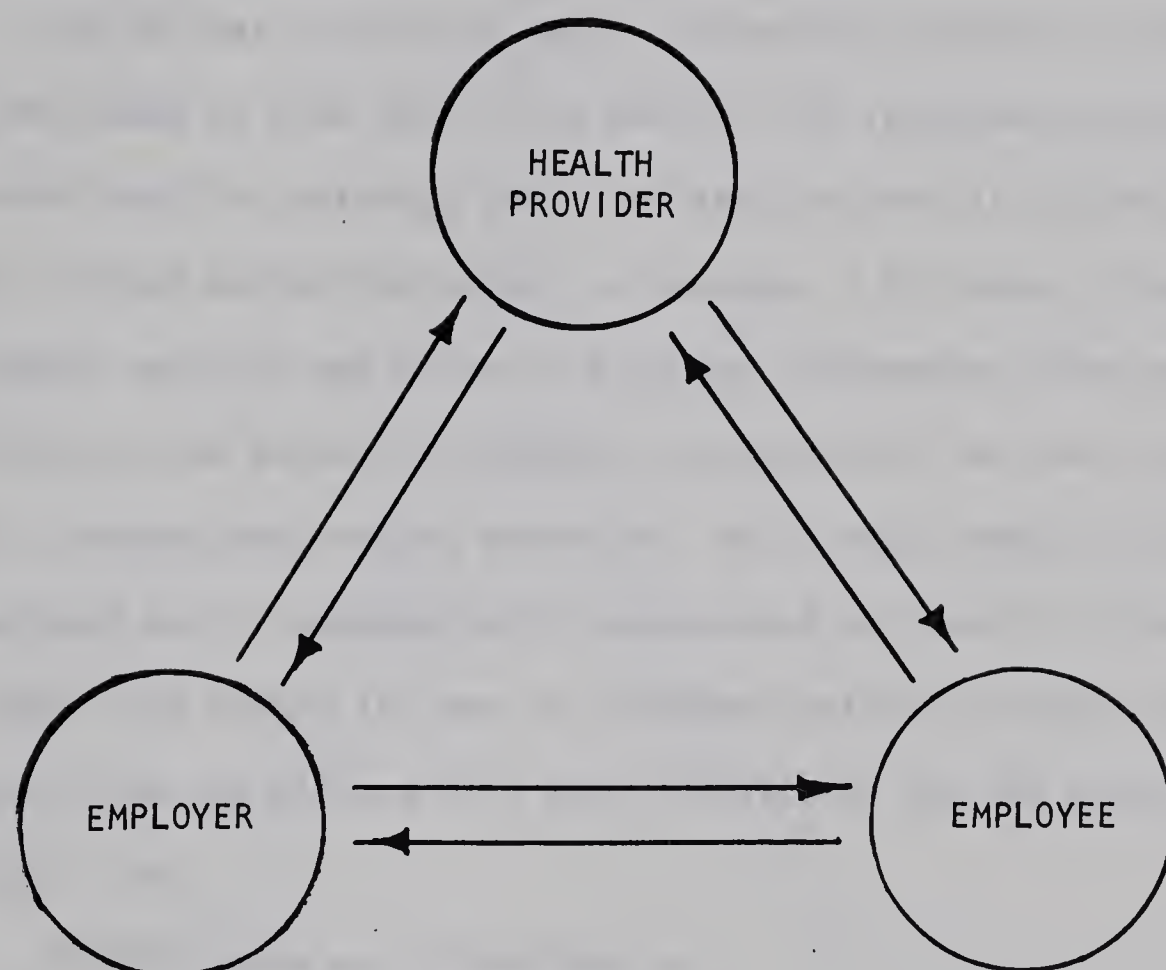


figure III

The Health Provider - Employer - Employee Interaction Consisting of Three Two-Way Communication Channels.





authoritative power. This latter situation is an optimal condition. The imposing weight of the employer pole is for instance evident during the rise of the Industrial Revolution. Social reform and rise of the medical knowledge and contribution has shifted the power balance within the HPr-Er-Ee set during the past century.

The HPr has to rely on valid information sources in order to satisfy the needs of both the Er and the Ee. For instance, an occupational nurse who fits earplugs has to be able to consult periodicals or better trained medical personnel in otology. A division of occupational health services has to be able to get information from specialized fields such as acoustics, otology, occupational law, sociology, economics, occupational health education. This large range of sciences can be grouped and is schematically represented as "Fields of Research Group" (FRG). See figure IV. One is reminded that the contacts between the industry and the FRG are also possible without the HPr being an intermediate link.

The HPr roles are formalized as:

#### Scientific Role

Pooling of information from FRG

Interpretation of information

Translation into a language understandable by Er and Ee

Pooling of Er and Ee needs to FRG

#### Social Role

Inform the Er and Ee

Start the hearing conservation program and keep it going.

The study of the industrial deafness problem can be proposed as investigation of:



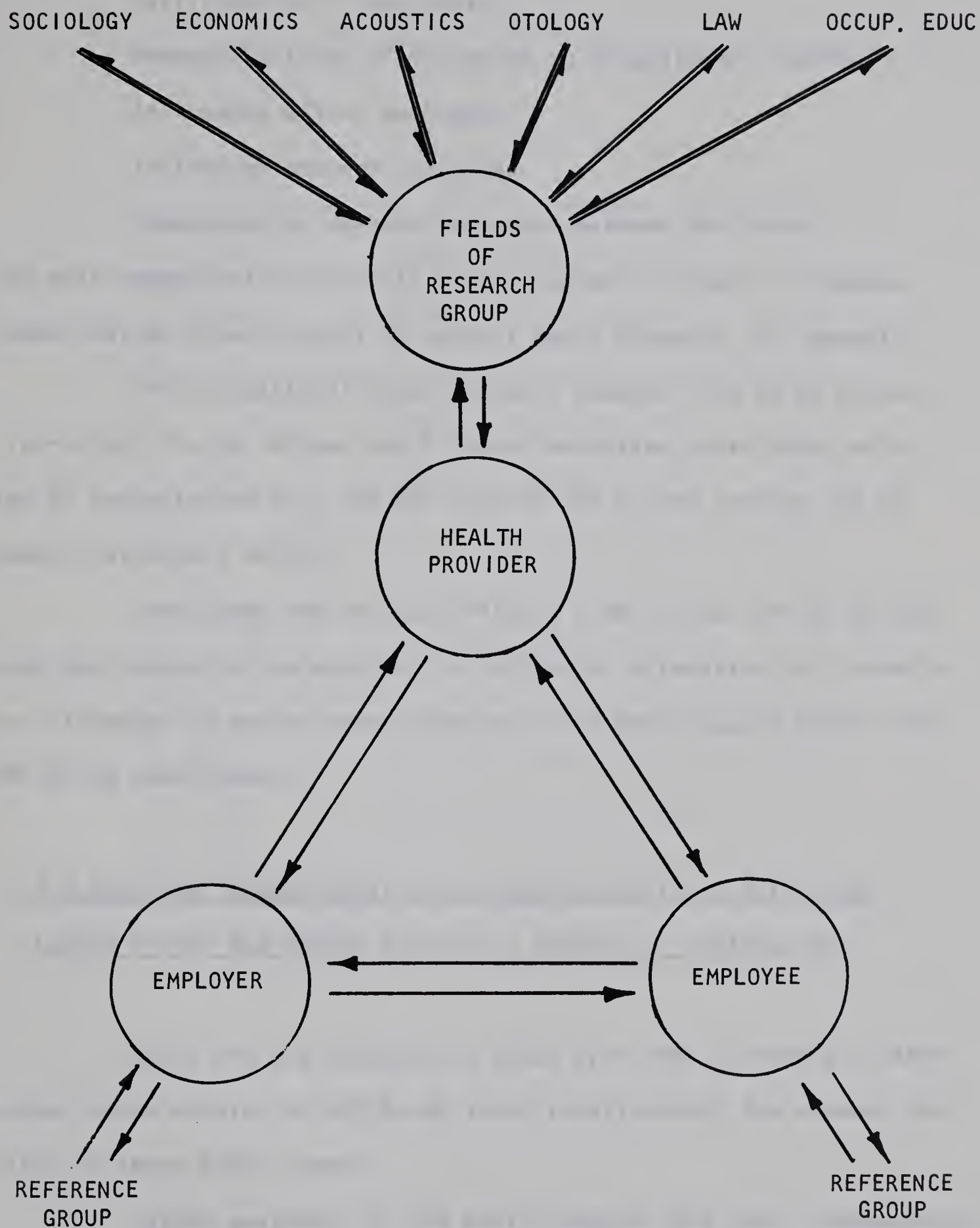


figure IV

The Health Provider - Employer - Employee Relation to the Fields of Research Involved with Noise and Deafness Mitigation



Participation in each pole

Responsibilities of the poles to occupational health

Influences within each pole

Influences between the poles

Communication methods and means between the poles.

The main communication channels are presented in figure V. Complex communication flows consist of several basic channels, for example:

The occupational nurse channels demands from Ee to Er and vice-versa. The Ee informs the Er about excessive noise about which the Er contacts the HPr. The HPr advises the Er who informs the Ee about preliminary action.

Every PONE and OD case reflects a particular HPr-Er-Ee balance and communication problem. Its effective alteration will greatly be influenced by mutual understanding of all participants within the HPr-Er-Ee relationship.

#### 4. The Potential Occupational Noise Exposure Shift to Safe Noise Levels within the Health Provider - Employer - Employee Set

Which are the consecutive steps from PCNE to AONE with safe noise levels within the HPr-Er-Ee inter-relationship? The process consists of three basic steps:

Latent awareness of the health hazards and their consequences,  
Conscious awareness of the health hazards and their consequences,

Cooperation within the HPr-Er-Ee set.

These steps are also valid for the mitigation of occupational health





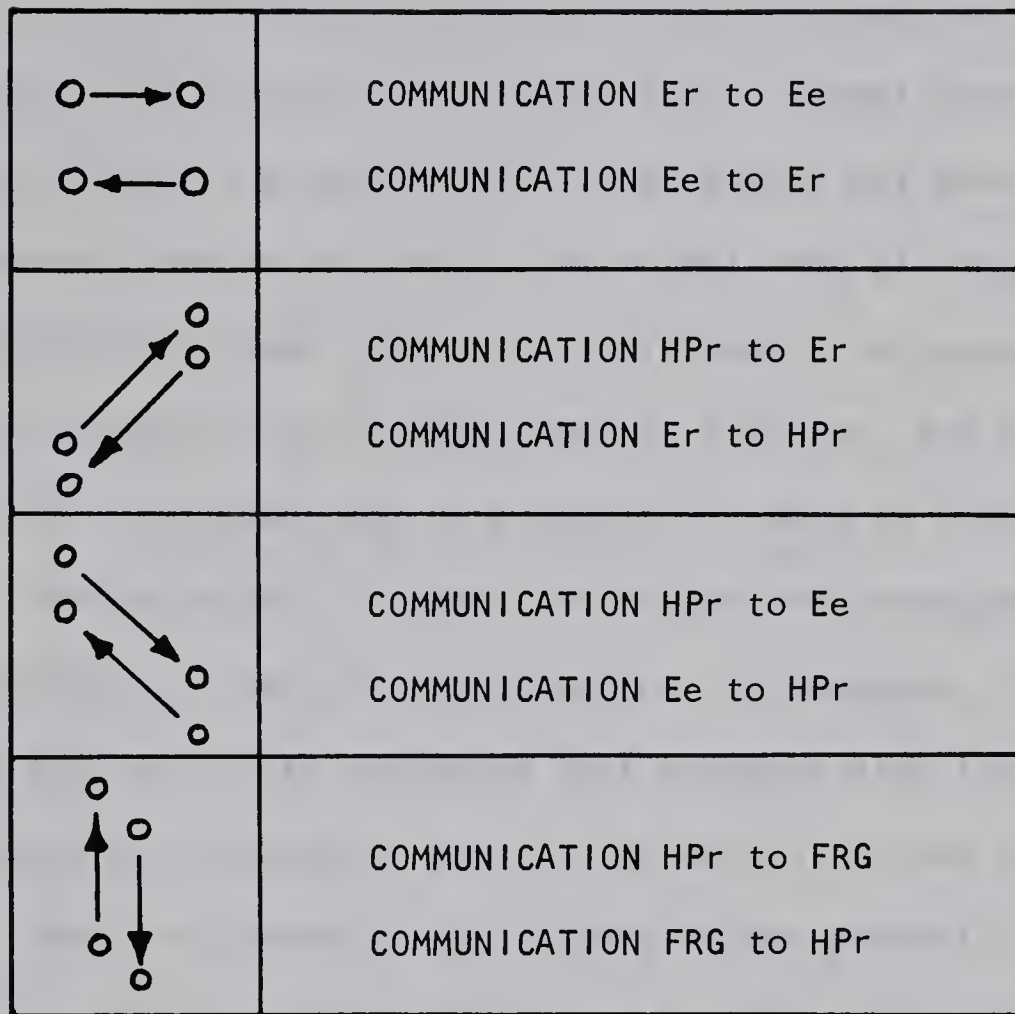


figure V

Basic Communication Channels between the Health Provider, the Employer, the Employee, and the Fields of Research Involved with Noise and Deafness Mitigation.



hazards other than PONE.

a) Latent Awareness of the Health Hazards and their Consequences

The employees are subjected to the hazard and obtain the symptoms of the disease but they are so used to them that they do not complain and they consider the situation as a normal consequence of the job. The employers are familiar with the hazards but because there are no complaints, they do not notice the threat. Not all medically trained people have been instructed sufficiently in occupational health to apply this speciality in their general practice. The hazards and consequences are present and no attention is paid to them.

Another aspect is where the hazard and consequences cannot be known because of lack of investigation. For example, it might actually be that work with equipment that produces high frequency sound is considered as undangerous now, but as harmful in the coming years.

The first stage is the closest to the potential occupational health exposure because no modifiers are used intentionally. There is no communication flow between the three poles in regard to occupational health. A common example illustrates this stage. A farmer may employ five agricultural workers. He has no medical service, but when an employee is sick he is allowed to consult the local physician. The HPr-Er-Ee set is complete. The physician's attention goes to the actual disease, which may be influenza, a tetanus, or any other disease, but rarely will he check the hearing of the worker, even if it is in a bad state.





b) Conscious Awareness of the Health Hazards and their Consequences

All three poles of the HPr-Er-Ee set are more or less aware of the PONE and the harmful effects. Their actions, however, are still in a preliminary state because the PONE modification to safe AONE levels is not yet reached. The contacts between the members of the HPr-Er-Ee group can still be insufficient, but all participants of the set are aware of the existence of the other poles. For instance, the unions and the business representatives may have received information about occupational noise by the HPr on state or national level.

c) Cooperation within the HPr-Er-Ee Set

The third stage develops from the previous one where the contact of one pole with the adjacent ones is sought purposefully in order to reduce or to eliminate the health hazard. The initial results may still be above the damage risk criteria, but the acceleration in the interaction is such that an eventual solution is in sight. The ultimate result is the lowering of the damage levels under the safety standards. It would be naive to accept that the Er acts in this stage only for humanitarian reasons. His interest might be the lowering of absenteeism and compensation board premiums or the increase of production.

d) Intermediate Stages

Although the alleviation of occupational hazards covers the higher mentioned stages, this does not mean that the HPr, Er, and Ee move together from one stage to the other. It might even happen that a pole is more or less left out of the mitigation process. For example, radiation has been dreaded so much that it actually affects a small



number of exposed employees.

The three stages of shift from PONE to AONE levels are represented in figure VI.

##### 5. The Third Dimension in the Health Provider - Employer - Employee Model

The HPr-Er-Ee model has been represented in a two dimensional plan, i.e., all HPr, Er and Ee have been handled as groups with the same characteristics. It is evident that the HPr, the Er, and the Ee represent a grouping of different functions and people. The basic model can be expanded to five layers as represented in figure VII. These are the individual, the employment, the state, the national, and the international levels.

The individual level contains the personal contacts, formal and informal with the HPr, the Er and the Ee as single persons.

The employment level contains the contacts, formal and informal, between the HPr, the Er, the Ee, within one and the same employment.

The state level contains the contacts between the HPr, the Er, and the Ee representatives on the highest administrative level within the state.

The national level represents the contacts between the HPr, the Er, and the Ee on the highest administrative level in the country.

The international level incorporates the representatives of all national deputies usually operating in conventions and international symposia.





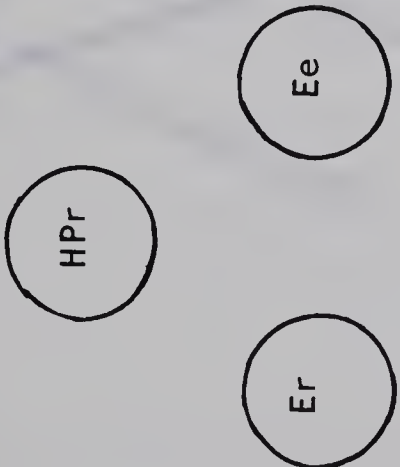
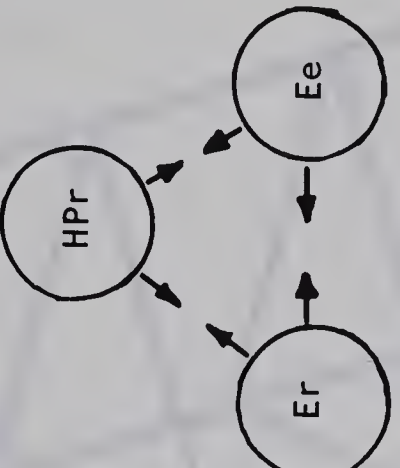
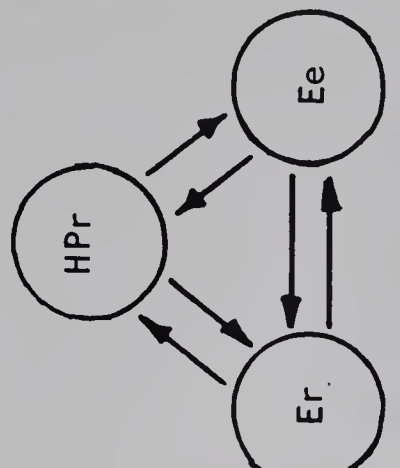
PHASES	LATENT AWARENESS OF HEALTH HAZARDS AND THEIR CONSEQUENCES	CONSCIOUS AWARENESS OF HEALTH HAZARDS AND THEIR CONSEQUENCES	COOPERATION WITHIN THE HPr-Er-Ee SET
SYMBOLIC REPRESENTATION			
CHARACTERISTICS OF THE PHASE	<p>Hazards and consequences unknown to the HPr, Er, Ee.</p> <p>Hazards and consequences known to HPr, Er and Ee, but not reacted upon.</p> <p>No contact between HPr, Er, and Ee regarding OD prevention</p>	<p>Hazards and consequences known to the HPr, Er, and Ee.</p> <p>Initiatives or preliminary contacts made, but no effective results at the present time.</p> <p>Inhibitors can be: Lack of knowledge in detecting and preventing the PONE and OD Financial inability Ineffective communication</p>	<p>Realistic expression of interest in the mitigation of PONE and OD within the HPr-Er-Ee set</p> <p>Efficient communication</p> <p>Acceleration of the mitigation of PONE and OD.</p>

figure VI

Shift of the Potential Occupational Noise Exposure to Safe Noise Levels over Three Stages.





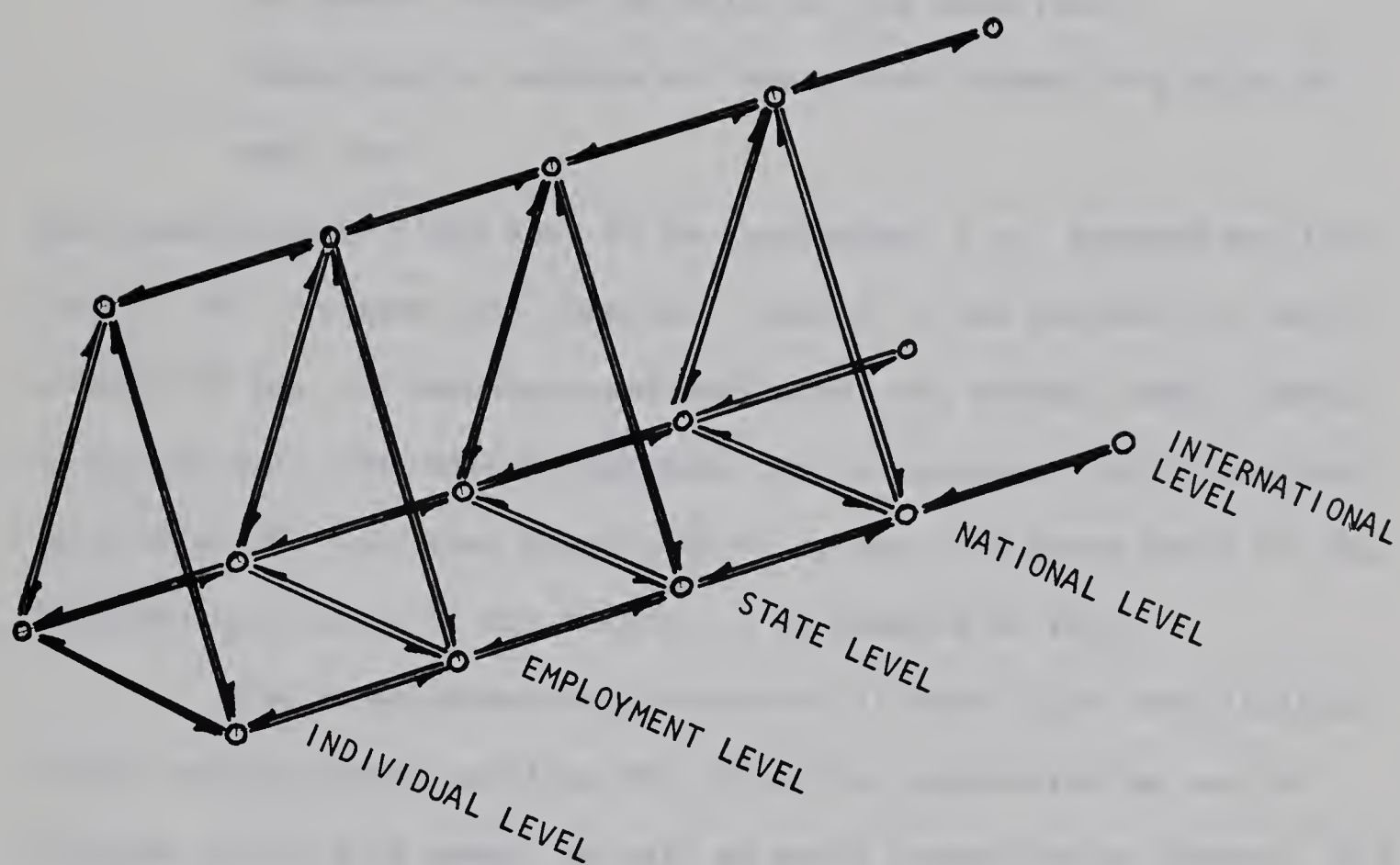


figure VII

Expansion of the Basic Health Provider - Employer -  
Employee Model in the Third Dimension



Each level contains a separate HPr group, and a separate Ee group. Each level consists of a basic triangular model with communication flows as described in section three of this chapter. The topics for investigation are valid for each model, i.e.,

Representation in each pole

Influences within each pole

Influences between the poles of the same level

Communication methods and means used between the poles of each level.

New communication flows have to be considered, i.e., between the five levels. For instance, an important channel is the national to individual HPr one, or the state and employment HPr avenue. Some interactions are only theoretical presences but not necessarily of practical existence. The fact that communication between the three poles of the international level is not likely, is an example of this.

The three-dimensional structure is both rigid and flexible. Rigid, because every existing HPr, Er or Ee representative can be located within this model, as well as every communication channel. The three-dimensional model is flexible, because sublayers can be introduced. This is the case for heavy industrialized areas where there are HPr, Er and Ee associations on local or district levels. The national and the state level can be combined into one level in a non-industrialized country.

The three-dimensional structure can also be represented in a chart containing horizontally the Er, the HPr, and the Ee. The individual, the employment, the state, the national and the international level are represented on the horizontal line. The communication chan-





nels are less evident. See figure VIII.

The organization of the investigation of the occurrence of OD can be handled in different cells. A new series of investigation elements can be introduced such as:

- a) Inquiry of the members present in each two-dimensional cell.
- b) Inquiry of the obligations of each member within the two-dimensional cells.
- c) Inquiry into the relation of each representative to general non-technical causes which underline the existence of OD. Such causes are also existing for the occupational diseases other than OD.
- d) Inquiry into the relation of each representative to specific non-technical causes which maintain OD. Such causes are not existing for other occupational diseases other than OD.
- e) Inquiry into the methods, means, and results of communication between the poles within and between the different levels.

Technical causality of OD is a study for acousticians and otologists. However, technical causes may be related to general and specific causality. The investigation of the OD occurrence can be compiled in a block form type, as is represented in figure IX.

#### Dimension One

The basically involved members such as the health provider, the employer, the employee.

#### Dimension Two

The levels which are the individual, employment, national and international.



	INDIVIDUAL	EMPLOYMENT	STATE	NATIONAL	INTERNATIONAL
EMPLOYER	IdEr	EmEr	SEr	NatEr	IntEr
HEALTH PROVIDER	IdHPr	EmHPr	SHPr	NatHPr	IntHPr
EMPLOYEE	IdEe	EmEe	SEe	NatEe	IntEe

figure VIII

The Health Provider - Employer - Employee Model Spread over Five Levels.



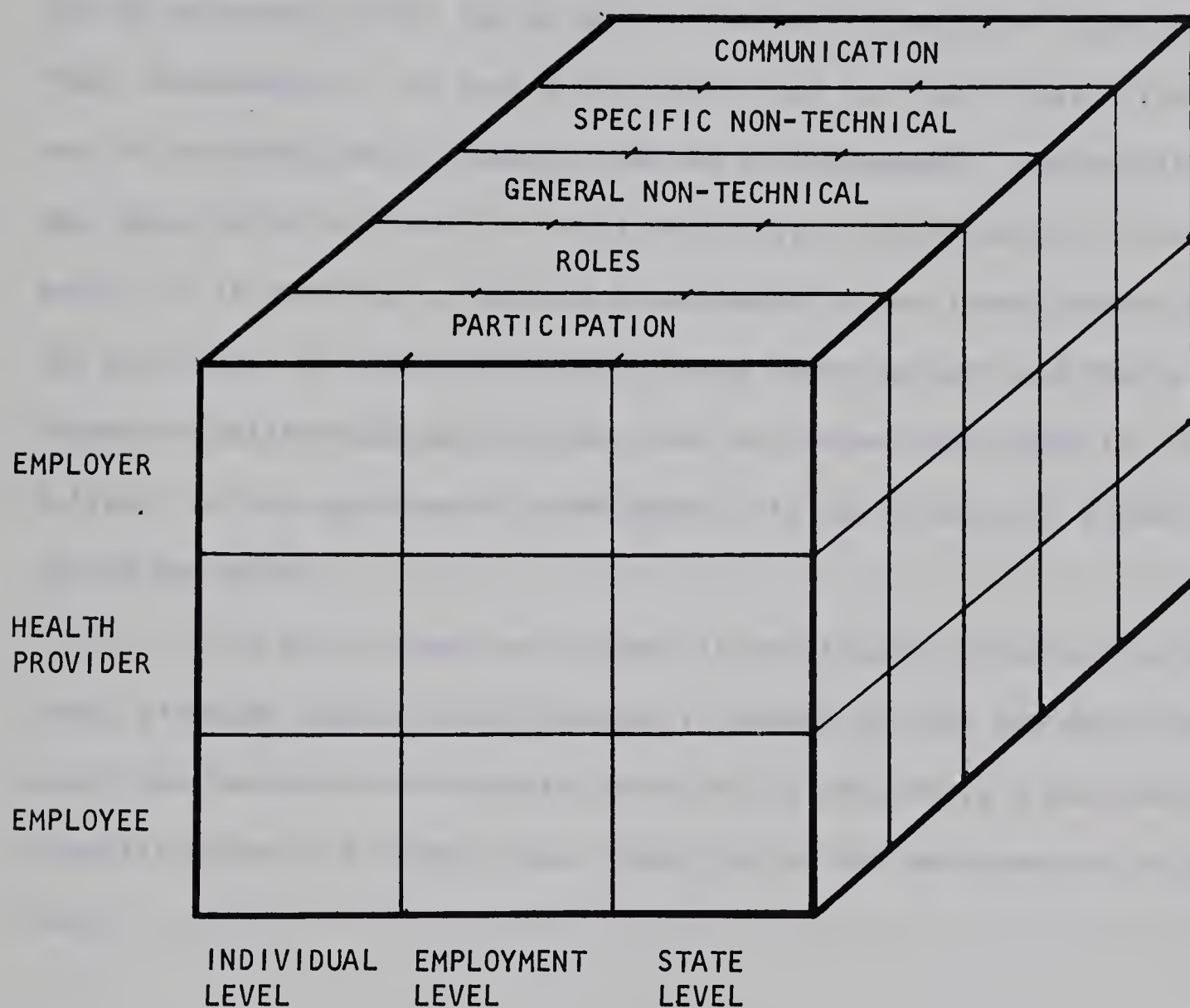


figure IX

Block Model Containing the Health Provider - Employer - Employee Model, the Five Levels, and Five Indicators for Investigation





### Dimension three

The inquiry types as outlined above in a, b, c, d and e.

Not all cells are expected to be filled with equal amounts of information. The block model is not valid for the investigation of the OD occurrence only, but as well for other occupational hazards and their consequences. The use of the model does not imply restriction in any of the demographic elements such as socio-economic, socio-cultural, sex, age, religion, urban or rural dwelling, or other factors. For example, it is possible to use the block model in the investigation of the occurrence of pneumoconiosis, among negro workers and Puerto Ricans as skilled and non-skilled, with an income from 1,500 to 3,000 dollars, of the age from 40 to 60 years, living in towns of 5,000 to 15,000 habitants.

The block model can be used in politically totalitarian systems, although special consideration is needed for the employer element. The introduction of health services on the job is a decision of administration at a higher level than that of the management of a factory.



## CHAPTER IV

### INITIAL STAGES IN THE ANALYSIS OF THE OCCURRENCE OF OCCUPATIONAL DEAFNESS

The two preliminary questions to be answered in the investigation model for OD are:

- 1) Who is involved with the occupational health problem?
- 2) What is the obligation of each member of the HPr-Er-Ee set within each of the described levels in the previous chapter?

The development of the study will further on be, "How can the state HPr best reach the individual employee in order to mitigate PONE and OD?" One is reminded that the hearing preservation of the IdEe is the ultimate goal of the SHPr action. The SHPr is the highest autonomous authority within an independent territorial unit with the specific role to wipe out OD and is equipped with legal power, access to knowledgeable information sources and to technical facilities and staff.

#### 1. Representatives of the Health Provider - Employer - Employee Set on the Individual, Employment, and State Levels

The involved populations in the individual, the employment, and the state level are represented in table V. Comments about each cell are set up in order to clarify some specific characteristics.





	INDIVIDUAL LEVEL	EMPLOYMENT LEVEL	STATE LEVEL
EMPLOYER	<p>IdEr</p> <p>Person on the job who is closest to the worker and who has authority over him, Foreman, Supervisor, Employer himself in the small plant.</p>	<p>EmEr</p> <p>Person or group of persons who manage an employment with PONE hazards, and who appoint workers to specific jobs.</p>	<p>SEr</p> <p>Division of occupational health services, Law enactor, Workmen's compensation board, Board of industrial relation, Factory inspectors.</p>
HEALTH PROVIDER	<p>IdHPr</p> <p>Individual who operates on personal terms with the worker in order to protect him from OD.</p>	<p>EmHPr</p> <p>Person or group of persons who organize the health service in the employment re OD prevention, First aid worker, Occupational nurse, Physician, Safety engineer, Industrial hygienist.</p>	<p>SHPr</p> <p>Grouping of managements within the state.</p>
EMPLOYEE	<p>IdEe</p> <p>Worker exposed to the PONE and OD danger.</p>	<p>EmEe</p> <p>Primary group of workers in the plant with informal contacts, Representatives of workers on the joint consultation board in the plant.</p>	<p>SEe</p> <p>Union organizations on state level, Labor council boards, Board of industrial relations.</p>

table V

Representation of the Employer, the Health Provider, the Employee at the Individual Level, the Employment Level, and the State Level.



### The State Health Provider

The SHPr represents the population of the state and attempts to mitigate OD through combined efforts of specialized individuals and groups. Some of the SHPr members are:

- The divisions of occupational health services

- The law enactors

- The workmen's compensation boards

- The industrial labor committees

The action of the SHPr is mainly reflected through the divisions of occupational health services, because they are the organized authority which are the most knowledgeable about PONE and its modification. Medical, acoustical and law specialists belong to the team. The SHPr operates mainly with representatives of labor and management, with national and international health providers. The SHPr is also an advisory authority to the employment health provider, to the management and the individual health providers. For example, a plant manager, a general physician or an occupational nurse can get information related to PONE and OD. Even the individual employee can contact the SHPr, although this is not preferable because of administrative difficulty for the SHPr.

The SHPr has access to a large group of researchers including safety suppliers, insurance carriers, universities, and national organizations which conduct research projects. Some of the latter group in Northern America are:

- The Subcommittee on Noise of the American Academy of Ophthalmology and Otolaryngology

- The Association for Speech and Hearing Disorders





### The State Employer

The state employer represents the grouping of management in the state. The primary function is to defend the business interests of all employers within the state. The SEr does not operate on the premise that occupational safety and health care have to be neglected in order that each of its members can make better profits. This body has no legal power over its members but works mainly in an advisory capacity. The SEr is an important intermediate between the SHPr and management.

### The State Employee

The state employee represents the grouping of all individual workers on the state level through organizations such as unions. Their primary concern is the preservation of the personal, financial, cultural and health interests of the labor force. The SEe operates with the SHPr and SEr and sends information to the plant representatives and to the individually associated members.

Also factory inspectors, labor councils and boards of industrial relations defend the interests of the workers. Their roles consist more of control of work conditions and advise to the SHPr and the SEe. They do not deal with the individual worker himself. They ask for corrective action from the EmEr and encourage the SHPr to do research and apply efficient control measures.

### The Employment Health Provider

The employment health provider is the formally appointed person or group whose role consists of rendering curative and preventive health service to the workers. Because OD cannot be cured, the role is mainly preventive action. The EmHPr function has a wide variety of re-





sponsibilities depending on the training level of the appointees. The latter can be a first aid trained worker who keeps personal hearing protective devices available, or an occupational health nurse, or a physician, or a hearing specialist. The EmHPr can also represent a group, e.g., a physician and a nurse. Also safety engineers, industrial hygienists, or labor welfare workers can be part of the EmHPr. The EmHPr varies from plant to plant according to the number of workers and the interest of the management in the health and welfare of their workers.

#### The Employment Employer

The employment employer represents the person or group of persons who produce goods and render service with the help of personnel. Their employment is considered as having an excessive noise level with a potential threat to the normal hearing of the workers.

#### The Employment Employee

The employment employee represents the grouping of individuals on the employment who are exposed to PONE. The contacts within the group can be of an informal character when the number of workers is small. Large plants will likely have worker representatives at the joint consultation boards with the EmEr.

#### The Individual Health Provider

The main characteristic of the individual level is the personal contact, or man to man relationship between the IdHPr, the IdEr and the IdEe. The IdHPr takes audiograms of the IdEe, equips him with personal hearing protection devices and advises him to safeguard his hearing. The IdHPr can contact management and notify it about suspected PONE elements or about improvements in the OD prevention. The



IdHPr also suggests adequate methods for OD mitigation. The IdHPr can be the appointed person, such as a safety trained employee, a nurse or a physician. The difference between the EmHPr and the IdHPr is the emphasis on the personal contact of the latter, while the accent on the overall responsibility and organization within the plant is the main contribution of the former.

The IdHPr can also be the personal physician or any other health worker of the IdEe. It can happen that this IdHPr has no contacts at all with the employment of his patient.

The IdHPr can also be both persons mentioned in the previous paragraphs. This happens frequently in rural areas where the local physician is equally the plant consultant concerning health matters.

#### The Individual Employer

The IdEr is the person closest to the worker and who has authority over him. In small plants it can be the oldest worker or the manager himself. The foreman or the supervisor represent the management in the large plant and deal personally with the worker.

#### The Individual Employee

The individual employee is the person appointed to a job by the management; a job which has a PONE hazard. The IdEe can be the only worker in the employment, e.g., in the case of a carpenter aid or a helper on the farm. The IdEe can also be an unobvious member of a large plant. Some IdEe jobs with PONE are shown in table VI. The number of employments with PONE is rising yearly. Note that jobs such as trucking and shipping have a PONE to the IdEe which is longer than eight hours a day.

Jansen (51) mentions:







Air hammers	Air line ground crews
Air craft pilots	Armed forces
Blasting	Building
Chipping	Combined harvesting
Compressed air	Contracting
Diesel engine shops	Drop forging
Engine testing	Farming
Foundry work	Gas pipe line stations
Grinding	Gun fire
Heavy industry	Hydrolic heat treating
Hydrolic presses	Jack hammers
Machinery manufacturing	Metal cutting
Missile launching	Oil pipe line stations
Paper mills	Petroleum cracking
Pile driving	Planing
Polishing	Printing press rooms
Punch pressing	Rock drilling
Sand blasting	Saw mills
Ship building	Textile weaving
Timber milling	Truck driving
Tunneling	Well drilling
Wire weaving	Wood working

table VI

Employments with Potential Occupational Noise Exposure.



Eine Besonderheit liegt nur insofern vor, als die Laermbelastung auf Schiffen in sehr vielen Faellen groesser ist als bei anderen Taetigkeitsbereichen in der Industrie oder im taeglichen Leben. Der staendige Betrieb von Maschinen auf Motorschiffen bedingt, dass bei laengeren Fahrten sowohl Schiffspersonal als auch Fahrgaeste einer staendigen hohen Laermbelastung ausgesetzt sind. Nicht selten entfallen daher die Ruhezeiten, die nach anderen Laermtaetigkeiten auf dem Lande stets gegeben sind. Daher koennte man folgern, dass fuer die Laermbelastung auf Schiffen eher strengere Regeln und strengere Massnahmen erforderlich sind, als sie in anderen Industriezweigen vorgeschrieben sind.

The author explains that the noise levels on ships are increasing and that the personnel as well as the passengers cannot escape the din. Jansen, for this reason, proposes stricter PONE regulations on ships than in the industries on land.

## 2. Roles related to the Mitigation of Occupational Deafness

### General outline of Roles

All individuals, study groups, health providers, social promoters and others who contemplate approaching industry concerning the OD prevention have to be well informed about industry, work groups, labor situations, attitudes of workers and employers, before they take a step.

OD mitigation has a good chance of efficient results if insight is gained by all involved members of the HPr-Er-Ee group in the nature of OD, its physiological, mental and social impact and the basic preventive principles.

According to Mueller (76) if the hearing of the labor force has to be preserved, it is necessary for all involved individuals to re-evaluate themselves continuously in the light of current needs, of





current expectations, of current potential for service.

All involved parties: the health provider, the employer, and the employee, have to realize that the lowering of hearing safety standards is unpermissible for reasons of labor shortage or financial gains.

#### Some General Roles of all Health Providers

All health providers have a definite responsibility to both, management and labor force. They have to be honest, so that their findings can be substantiated by another observer completely disinterested in management and labor force (56). They act as non-participants in the Er-Ee conflicts (57). They have to be able to bring grievances and misinterpretations into proper perspective. They have to promote interest in the industrial and general population, because according to Mueller (76):

In a society where the voter is king, the public interest must always be paramount for it is not a long step between public interest and congressional legislation.

#### The State Health Provider Role

The Committee on Pollution of the National Research Council in the United States (19:204) mentions that the SHPr, who has legal and technical powers, has to cooperate with as many authorities as possible. The same author mentions:

The philosophy of recent legislation suggests especially a conviction on the part of the federal authorities that programs for pollution control should be progressive or continuously developing and that they should be collaborative engaging all levels of government and both public and private constitutions.

According to Parent (82), the SHPr operates on state, public and industrial monies and is required to see that results of research





are used in a manner which best serves the interests of the industrial populations. The research has to be in the field of technical, as well as medical causality of OD, on the workers' and employers' attitudes and their rejection of OD prevention, on the effectiveness of propaganda regarding programs (22).

As adapted from Felton (28), the SHPr must also construct systems of continuing education for the physician and others engaged in OD prevention, so they will learn new facts and concepts and revise or discard outmoded ones.

The SHPr has a scientific and social role as is sketched in figure IV. The contact has to be established through efficient channels with reliable intermediates. The latter can be the EmHPr, the IdHPr, the SEr, the EmEr, and others.

#### The State Employer Role

The SEr is an advisory authority with no legal power over its members. However, as it receives information from the SHPr and complaints from the SEe, this body has to emphasize to its members the risk of exposing:

- a) The labor force to excessive hearing damage.
- b) Its members of financial and material losses through further delay of safety action.

#### The State Employee Role

The SEe protects the health of the labor force and submits complaints and information about questionable working conditions for investigation by the SHPr.

The SEe submits motions to be enacted such as at the Canadian Labour Congress annual Health and Safety Conference held in



London, Ontario, November 1967 (15:7).

Subject: Legislature to provide maximum noise level standard, emphasizing engineering, isolation, and personal protective equipment.

That the C.L.C. make presentation to the Federal Government, strongly recommending changes in legislation to provide relief and protection for employees in many places of work, and that the C.L.C. strongly urge the Provincial Federations of Labour and Labour Councils to make presentations to the Provincial Governments to change Compensation Acts to provide adequate coverage for loss of hearing, change Compensation Acts to provide adequate protection, and that Local Unions be urged to write Provincial Federations of Labour and Labour Councils, requesting that these presentations be made.

The SEe has to cooperate on the international level with the SEe of other states involved in similar employment hazards, for example (15:8):

As regards the FOREST INDUSTRY in the CANADIAN WEST, the Regional Council No. 1 of the International Woodworkers of America (which has locals in British Columbia, Alberta, Saskatchewan and Manitoba), reports an increase in intensity and importance of the noise hazard since 1962:-

International Woodworkers of America AFL-CIO-CLC  
Regional Council No. 1 March 8, 1968

The IWA is greatly concerned with the question of industrial noises, because the high powered motors that are used in our industry are continuously increasing in size with no improvement in muffler systems. We are in support of the program of the B.C.W.C.B. in taking sound readings in our industry. Our union is of the opinion that any reading above 85 decibels is injurious to anyone exposed to a higher noise level over a period of time. Unfortunately, noise control has been ignored until the last few years, and it appears to be another case of 'too little too late'. My personal opinion is that the only totally effective noise control is in the design of machines with built-in operator protection. This will take considerable time, and probably will only be instituted when it becomes a requirement by statutory law.

Regional Safety Director (15).







The SEe has to advise the workers through the union system about PONE and OD by contacting their representatives at the employment level. If there are no representatives, the worker has to be advised personally.

#### The Employment Health Provider Role

The EmHPr role consists of the development and the administration of the OD prevention in the plant. The following pattern of service is set up by Holmes (48:12):

- 1) To make good health an asset by the community.
- 2) To encourage the full use and development of health services.
- 3) To teach people how to achieve good health.
- 4) To encourage them to achieve good health by their own action and effort.

Felton (29) adds to this:

While all of this tetrad applies to occupational health, it is the second and fourth aims that industry emphasizes, along with a fifth: To attain maximal health, which will permit most effective, productive output. This last aim is reached by the minimisation of absence due to illness, by the lowering of labor turnover because of emotional or physical causes of personality disruption, and by the decreasing of the number and severity of work-related injuries.

Specifically related to OD prevention, the EmHPr role consists of:

- 1) Establishment of pre-employment audiograms and follow-up hearing tests as an industrial routine (36),
- 2) Supervision of job placement related to OD,
- 3) Job termination hearing examination,
- 4) Keeping records of audiograms as evidence material in case of claims,
- 5) Maintain an active interest in possible causes of PONE and OD,



6) Make regular inspections of hearing hazards.

Maisel (72:67) quotes:

The well trained industrial nurse or physician can either spot hazards on the basis of their knowledge and experience or will know how to get the necessary information promptly through medical channels or through the industrial hygiene services maintained by a number of state and some city health departments.

7) Report to the employer the existence of potential hazards on the employment with specific reference to OD.

Maisel (72:71) synthesizes the EmHPr presence in the industrial setting as:

It is reassuring to Ees to know that plant conditions are under observation by medical personnel. It is equally satisfactory to employers to realize that proper records ... are available in case claims arise out of alleged harmful conditions of work.

### The Employment Employer Role

Some of the EmEr roles are reflected through the citations of well known occupational health authors or organisms.

Lehmann (59) mentions:

The aim of technological development should be to serve man, to make his life more agreeable and enrich it. So logically, technical progress should lead to less noise, not more.

The American Mutual Insurance Alliance (4:18) mentions:

Industry must do everything possible to protect its workers from greater than average hearing losses sufficient to result in handicap.

The American Industrial Hygiene Association (3:155) mentions that the basis of an industry's obligation stems from the common law that it is the employer's duty:





To use ordinary precautions  
 To warn the employees of danger  
 To provide a working place safe to hearing.

The British Columbia Mines Regulation Act (15:3) contains:

The manager shall take all reasonable measures to ensure that noise levels do not exceed suitable standards.

Where noise levels exceed suitable standards, the manager shall provide suitable protective devices.

No persons shall work where excessive noise levels exist without wearing such equipment.

According to Davies, Davis and Tyrer (22), once standards have been agreed upon, the responsibility of attaining and maintaining those standards is the role of management. The workmen's compensation system permits the EmEr to meet the safety obligations with the cost being passed on the consumer in the price of the manufactured product (3:152).

According to Hazen, Roberts and Young (43), the EmEr must have a basic interest in health and the time, enthusiasm, ingenuity, and the sincere desire to participate in the deafness prevention program.

According to Maisel (72), the EmEr must permit the EmHPr to devote a substantial part of his working hours to the identification of hearing hazards. the same author (72:73) further stresses that:

1) The EmEr must seek for technical and professional competence and the performance of specific tasks essential to the fulfillment of the role of whatever occupational health program a company may have.

2) The EmEr must recognize that the doctor's first responsibility is to the IdEe and that there can be no encroachment upon the





ethics of this relationship.

### The Employment Employee Role

The workers' grouping in the small plant has no specific roles related to the OD prevention. The responsibility rests on the worker himself. The representatives of the workers on the employment have the duty to:

- 1) Be aware of the PONE possibility and inform both, the EmEr and the IdEe.
- 2) Advise and encourage the workers to follow the safety directions proposed by the EmHPr.
- 3) Urge to safe noise levels.
- 4) Inform the SHPr either directly or indirectly in order to investigate and enforce changes if there is no action by the EmEr.

### The Individual Health Provider Role

The main part of the IdHPr role is the personal contact with the IdEe and the IdEr superior to the worker. The IdHPr is present as well inside as outside the plant.

### The Individual Health Provider Inside the Plant

Some of the roles are dependent on the degree of training.

The American Industrial Hygiene Association (3:79) gives an example:

Most audiometric testing is carried out by a nurse, a technician or another employee of the medical department who has been trained in industrial audiometry. Any person so trained should consider audiometric examination a major responsibility and maintain checks on the accuracy of the hearing level determinations. However, no attempt at diagnosis or interpretation of the audiometric results should be made by the technician. Questions about the results of such tests should be referred to the responsible physician who is familiar with the audiometric program.

Sataloff (91) mentions some more physician roles: The plant physician



decides:

1) If the applicant's hearing be further damaged to a handicapping degree by exposure to the noisy job.

2) If a small degree of further hearing loss will lead to the possibility of a claim.

3) If the applicant is so highly skilled, that he is essential in the particular noisy job.

4) If the risk of further deafness is almost inevitable because of the applicants vocation.

The IdHPr role is not a physician's exclusivity. Some other in-plant health workers such as safety staff members or an occupational health nurse or a hygienist can fulfill a part of the OD prevention program. The IdHPr exhibits sympathetic understanding while at the same time making clear that the IdEe is accountable for his action (21). The IdHPr educates the IdEe in such a way that he understands the purpose of hearing conservation and does not unnecessarily oppose his employer. This is a role of the interpretation of industrial health services to the employee. The IdHPr learns about the home influences of the IdEe and he spreads information to the home using the worker as an intermediate.

Personal hearing protection such as earplugs or earmuffs can be widely used in industry. The IdHPr has to be prepared for remarks and questions concerning the use of these devices. Therefore it is important to know that (65):

Plugs should be pliable and fit tightly,

Plugs work loose and must be reseated,

Plugs do not cause infection,







Plugs must be kept clean,

Ear protection makes it easier to understand speech and warning signals in noisy conditions,

The best ear protector is the one that is worn,

Ear protection devices must be fitted by trained personnel.

### The Individual Health Provider Outside the Plant

The personal health consultant of the IdEe, i.e., his personal physician, a public health appointee or a social worker has to be familiar with the threat of noise exposure in industry. He should be able at least to suspect inadequate hearing and to advise his patient to visit a hearing specialist. The otologist can do all audiometric testing, make decisions in problem cases, and testify as an expert in medico-legal problems (91:292).

### The Individual Employer Role

The IdEr acts as an intermediate between the EmHPr, the IdHPr, and the IdEe, being, for example, a supervisor.

Maas (65) notes:

Supervision must sell the employees on the need and value of hearing protective devices.

Supervision needs to make itself an example in the wearing and promotion of hearing protection.

Landsberger (57) notes:

A good supervisor must provide his group with a certain minimum of initiating structure or technical and administrative activities.

A good supervisor should do his structuring in a participative democratic fashion, consulting his subordinates, holding group meetings, responding to suggestions.

### The Individual Employee Role

The IdEe has the obligation to try to preserve his health by



the best possible means (90). It is socially undesirable to grow dependent on family, fellow workers and the taxpayers.

The IdEe has to carry out all safety regulations advised for his protection against OD. He is responsible for the proper use of the personal hearing protective devices.

The IdEe has to report susceptible noise hazards to the management representatives.

The IdEe has to report suspected hearing losses to his immediate IdEr or the IdHPr.



## CHAPTER V

### INVESTIGATION PROPOSAL FOR SOME ESSENTIAL ELEMENTS OF THE OCCURRENCE OF OCCUPATIONAL DEAFNESS

Up to this point, the presence and roles of the individual, the employment, and the state members have been worked out, in developing the block model of figure IX. The next step consists of the exploration of the general and specific non-technical causes of the occurrence of OD. The general causes are those which are common to occupational diseases and to OD. The specific ones are only present for OD and not for other occupational impairments.

A safe progression in the investigation is the breakdown in a number of factors which are still open to further qualitative and quantitative study. Some of the proposed concepts may seem controversial or biased. However, they have to be interpreted in the light of introductory elements, and less as conclusive evidence. Substantial evidence is collected from literary sources and through personal contacts with occupational health authorities.

#### 1. Conceptual Definition of the Occupational Deafness Phenomenon

The problem is no longer one of defining clinically what occupational deafness is. Ramazzini (87:438) quotes the OD in his work "De Morbis Artificum" of 1713, which is considered as the first medical approach to occupational health.





In every city, e.g. at Venice, these workers are all congregated in one quarter and are engaged all day in hammering copper to make it ductile so that with it they may manufacture vessels of various kinds. From this quarter there rises such a terrible din that only these workers have shops and homes there; all others flee from that highly disagreeable locality. One may observe these men as they sit on the ground, usually on small mats, bent double while all day long they beat the newly-mined copper, first with wooden then with iron hammers till it is as ductile as required. To begin with, the ears are injured by that perpetual din, and in fact the whole head, inevitably, so that workers of this class become hard of hearing and, if they grow old at this work, completely deaf. For that incessant noise beating on the eardrum makes it lose its natural tonus; the air within the ear reverberates against its sides, and this weakens and impairs all the apparatus of hearing.

The major problem is the conceptual definition. Is OD an occupational "Disablement", an "Impairment" or a "Disease"? These differences are apparently of minor importance. However, they are not, because in Northern America some workers who are affected with OD can be compensated in the case of disability but not for a disease, and vice-versa.

The sudden acceptance of OD has produced consternation and confusion in legislation since 1948.

Glorig (37) states in 1960:

Ignorance of known facts about the relations of hearing loss to noise exposure led to hurried and questionable decisions about damage risk criteria, particularly with respect to disability laws and to rating scales.

The same author further mentions some differences and changes in the conceptual definition:

The complexity of the noise problem is readily seen when the medico-legal aspects are considered. In a discussion of the medical principles underlying the evaluation of noise-induced hearing loss, we would use the term "disability" in its usual medical sense of "loss of normal function." It appears, however, that the word has acquired a legal meaning which is considerably narrower than and quite different from its usual medical meaning.



In the interest of preventing confusion we propose to use the term "impairment" which now has no legal connotation, in place of the more ambiguous term "disability."

What constitutes "impairment" caused by hearing loss? The function of hearing is used by man for many purposes, but the one most important to the large majority is undoubtedly the hearing and understanding of speech. If hearing for speech is the most important common use of the auditory function, then it is logical to assume that loss of hearing for speech should be the basis of determining impairment.

The original purpose of compensating for "disability" was to replace reduced earning capacity which resulted from occupationally-induced impairment. Obviously the common denominator of hearing is communication by speech, not whether one can hear the top note on the piano. Is it not fair, then, to assume that impairment rating should be based on the effect of loss of hearing on hearing and understanding speech? The medical profession thinks so, and has proposed a method of rating impairment on this basis.

An example of change in the use of concepts is the Georgia Precedent of the Shipman versus Lockheed Aircraft Cooperation case in 1962 (4:3). The Georgia law in Section 114-102 states that:

"Injury" and "Personal Injury" ... shall mean only injury by accident and shall not, except as hereinafter provided, include a disease in any form.

OD is not included in the previous statement. The Georgia law in Section 114-803 states that:

The term "occupational disease" shall include only those diseases hereinafter listed in this section ...

OD is not included in the previous statement. The court has ruled out in the above mentioned case that the loss of hearing has been the cumulative effect of a succession of traumatic injuries suffered by impingement of each sound impulse upon the ear. In Georgia, hearing loss is compensable under the accidental injury provisions of the law.

The OD is compensable as an occupational disease under the disability schedules in Missouri since the 1959 Marie versus Standard







Steel Works case (4:2).

The definition of the date of injury is also an item for controversy because of the gradual appearance of OD. The Wisconsin regulations define the date of injury since the Wojcek versus Green Bay Drop Forge Company in 1951 as the last day of work for the last employer whose employment has caused disability.

In how far are differences in definition a disadvantage in the mitigation of OD?

1) Differences constitute delay in national protective legislation and make comparisons difficult between state laws.

2) The introduction of OD preventive laws is delayed in states which do not yet provide legal protection. Some examples can clarify this point. The American Mutual Insurance Alliance (4:17) mentions:

... amendments to the laws which would have added occupational loss of hearing to the schedules without specific requirements embodied in the Wisconsin, New York and Missouri laws have been proposed but not enacted in Arizona, Colorado, Illinois and Massachusetts.

Linster (61) mentions in 1961:

There are 15 states in which loss of hearing due to industrial noise should not be compensable unless it was due to accident or a series of accidents because only enumerated occupational diseases are covered and occupational deafness is not one of the enumerated diseases.

3) Differences develop loss of authority within the state and delay in court decisions, because of continuous referrals to different procedures for similar facts.

4) Interstate and international companies suffer economical losses when they are confronted by different legislations. A state



with tough legislation can suffer substantial industrial losses to other states.

## 2. Responsibility Taking in the Occupational Deafness Prevention

Occupational health education, industrial sociology, otology, legislation, acoustics and other fields are partly involved in the mitigation of occupational hearing loss. All have to contribute to the reduction of the number of exposed workers being affected by PONE. All view the situation from a different frame of reference and with a different set of attitudes. Which group initiates, administers, and evaluates the progress, shortcomings, and the renewal of the program? The responsibility factor is controversial. Usually the medical profession claims the biggest say.

The Subcommittee on Noise (103:8) advocates the following position:

The conservation of any human function is primarily a medical responsibility. Hearing is no exception. prevention, diagnosis and treatment of hearing loss: validation and approval of audiometric records; and the final assessment of measurements of hearing are medical responsibilities. Any hearing conservation program without medical supervision must be considered inadequate.

The position of the American Mutual Insurance Alliance (4:46) is:

Responsibility for loss of hearing rests primarily upon engineering and technical groups, both as respects insurance carriers and employers.

A set of combined responsibility is worked out in California.

Bell (10) mentions:





In California an All Industry Noise Committee was set up to develop a constructive hearing conservation program to reduce hearing losses caused by industrial exposure aided by medical, legal and technical sub-committees.

How has the industrial deafness problem developed on a basis of lack of centralization and responsibility taking? Schenker-Spruengli (96) approaches this question from a social and legal viewpoint.

Primarily because social and legal measures were not taken to prevent it, and for the failure to act in time the public authorities bear the major responsibility. For far too long the spread of noise was accepted as a natural process, as a price to be paid for our technological progress. Law, justice and public authorities all capitulated to technology. In such a situation the average person tended to feel, and to become, helpless. The first wave of protest gave way to resignation. People shrugged their shoulders and said, "There is nothing we can do about it."

Can the problem be solved through tough legislation? Beales (9:176) considers:

The legislation regards noise as a mere 'nuisance' and it should be as a 'danger'.

Beranek (12) uses an example from traffic noise:

Some people demand their parliament for tougher legislation and forbidding high noise levels. However, a law that would specify lower maximum acceptable levels to be met by all operating aircraft will do little immediate good, since most of the today's aircraft cannot meet a substantially lower noise requirement.

The Committee on the Problem of Noise mentions in the Final Report (20:128) the difficulties involved with legal action:

If early legislation were introduced it could do no more than lay down general standards, the effect and the cost of which cannot, at the present, be estimated. If the standards adopted proved to be too severe in some respects, the industries affected might be exposed to heavy unnecessary expenditure; on the other hand if minimum standards were adopted, these would tend to suggest that compliance with these standards was all that was needed in parts of industry where there were





important hazards at lower sound pressure levels or with shorter exposure. Legislative insistence on the wearing of ear protectors would be particularly difficult to introduce until there is a wider recognition of the need for them in noisy industries. Early legislation would, therefore, have to be very general in its terms and it would be impossible to enforce effectively.

Glorig (36) mentions that the eventual magnitude of the noise problem will depend on how it is viewed by the total community and particularly the industrial community.

The "Who has the overall organization duty?" is not yet answered. The contribution in occupational health literature and in conventions is limited to specific topics without attention to other disciplines which are part of the problem.

The National Education Association (78) mentions:

Knowledge of the scientific fact and the principle is in itself insufficient in the progress of health education.

The previous statement can probably be changed. Knowledge of the potential occupational exposure of noise and industrial deafness is in itself insufficient in the process of its mitigation. How then can an occupational health program run adequately and be a guarantee to its clientele if the basic administration is based on debateable centralization and responsibility taking? Are the claims by the medical authorities for complete supervision justified? Can the medical profession give the ascertainment to administer the OD program well? Is there no danger that joint responsibility is going to result in fragmented, separated, research projects with delay of impact on the problem itself?

The responsibility problem is not only one for the top health provider levels in a nation, but it also exists in the employ-



ment. Some statements can be used as examples of diversity of viewpoints on the employment level.

Sataloff (91:292) states:

... coordination of the program and the overall direction of its various aspects are the responsibility of the industrial physician.

The Subcommittee on Noise (103:8) makes a similar declaration:

Although the actual operations of measurements and protection are performed by both medical and non-medical personnel, the physician ultimately is responsible for the health of the employee.

Maisel (72:221) states:

The provision of a safe work environment is the joint responsibility of many elements in industry.

Riley (88) points out:

The initiation of an industrial noise control program is definitely a management decision.

Davies, Davis and Tyrer (22) point out the extremes in the prevention program:

The doctor has not the means to measure the environment; the industrial hygienist does not claim to know the patient.

These differences in opinion have not to be considered in their absolute sense, but in the light of possible controversies on the employment level. There is a need for a clear-cut outline on responsibility priority. The actual situation is one of the unanswered question of: "Who has to be consulted by whom in the OD mitigation program?" Bell (10) gives a kind of compromise answer:

The physician is best qualified to judge whether combined efforts have been effective and any program that does not include a medically trained person is likely to prove inadequate, though the leadership and composi-







tion of the team must be dictated by circumstances.

### 3. Priority of Hearing Protection over other Occupational Hazards

Which priority has to be given to OD prevention in regard to other occupational diseases? Deniston, Rosenstock and Vetting (24) put the question:

Are our program objectives worthwhile and do they have a higher priority than other possible objectives of this or other programs?

The comparison between occupational diseases is very difficult because of the differences in the nature of the impairments. For instance, are there common grounds to compare 50 per cent hearing loss with 50 per cent visual loss? OD is not only the physio-pathological deterioration or an audiometric shortcoming, but also the loss of contact in the social activities. How can mental and social impact be measured? Are the mental and social impact of deafness and blindness the same? The impact of OD has already been outlined in chapter II. The number of workers exposed to PONE and OD is greater than for any other disease resulting from hazards on the job.

Maas (66) mentions:

Although one half of America's workers earn their living in noise levels of working conditions exceeding 85 dB which we know are hazardous, he (the worker) still accepts noise as a normal part of his occupation.

The Committee on the Problem of Noise states in the Final Report (20):

In our judgement the present level of noise in our community is such that some additional cost in money and in restriction of liberty to make noise is justified to prevent further increase and in time to achieve



some reduction.

#### 4. Differences of Standardization in Various Disciplines

Valid standards are concrete indicators of the application, of law, in the outline of acceptable noise levels for manufacturing, in the closing down of work opportunities with excessive noise hazards, in the compensation and in other factors.

The divergence in state standards causes the same delays as outlined in section one of this chapter.

Sherwood (99) expresses the need for uniformity:

If noise control programs are to go forward as swiftly and economically as possible, it is imperative that international standards be published soon. If this does not occur then there is a risk that individual companies may be forced into developing their own standards. Further in the absence of an international standard, individual and local authorities may well develop differing standards and regulations. Already a standard has been developed in the United Kingdom which differs considerably from draft standards in Germany.

Beranek (12) illustrates through a traffic noise example the need for state, national and international uniformity in standards:

Hit-or-miss municipal and state laws designed to control noise of surface transportation generally are not effective. Trucking today is largely between countries or states. The increased costs of providing and maintaining mufflers and engine covers are such that compliance will be assured only if they are international or national and apply to all vehicles.

Which are the underlying principles in noise standardization? The American Industrial Hygiene Association (3) states:

Although there is a common agreement about the need of criteria, there is a considerable disagreement about the suitability of criteria levels.

A criterion may be set at a level intended to provide





minimum risk, maximum safety or somewhere between those extremes. The user of the criterion and the person to be protected may and probably do, have different ideas about where this level should be. It therefore becomes apparent that an equitable criterion for regulatory purposes must be a product of compromise.

Which are the difficulties about agreement on safety standards from an otological viewpoint?

Glorig (37) mentions:

The fact that noise exposure produces a hearing loss is well substantiated. We do not know, however, what circumstances will produce how much hearing loss in how many people.

The Subcommittee on Noise (103:12) mentions:

Prevention of hearing loss in every person who is exposed to noise may not be possible. Some few ears may be highly susceptible to noise induced hearing loss. As yet, there is no predictive test that will enable us to identify persons with highly susceptible ears. No practical general rule of protection is equally effective for all persons exposed to noise; the protective measures that prevent loss of hearing in ears that are normally susceptible may not be effective for highly susceptible ears.

There is also the problem of rating hearing loss and impairment. What percentage of impairment corresponds to a given number of decibels? This case constitutes again a responsibility problem.

Glorig (37) mentions:

Evaluation of the impairment is strictly a medical function ... The compensability of hearing impairment is a community decision.

It is right that the medical profession has little to do with the number of dollars to be paid out, but is the first part of the statement also true? Can the medical profession be the only decision maker, where X dB correspond to a percentage of impairment? There is not only the hearing and the understandibility aspect, there is also the mental impact on the patient. Therefore social psychologists,





sociologists, linguists, occupational health educators should be involved as well as the medical discipline.

All over Northern America, different rating scales are used for the evaluation of hearing loss. There is the American Medical Association Method of 1947, the improved American Academy of Ophthalmology and Otolaryngology (AA00) method of 1959, the variation of the AA00 method used in California since 1962 (4:37). The Canadian Provinces have another unpublished method.

There is the controversy about the presbycusis allowance.

Glorig (4:40) mentions:

Threshold shift that accompanies aging is of interest medico-legally because it is found in the general population. Certain amounts of shift accompany age, in groups of persons not exposed to occupational noises. It is reasonable then, to assume that some sort of correction for loss of hearing due to aging should be allowed in compensation cases. Because of the complexity of the problem, however, it is impossible at this time to designate a correction that can be said to be scientifically valid.

A similar statement is made by the American Industrial Hygiene Association (3:154).

Glorig (36) mentions:

Corrections applied for the expected loss due to age cannot be proposed yet, because the inter-relations between the aging process are not adequately understood. We are quite certain that aging does not produce significant hearing loss in the average person.

The AA00 has not taken a position in the allowance to be made in the compensation cases for hearing loss due to aging when the new evaluation formula was proposed in 1959, as mentioned above.

The American Mutual Insurance Alliance (4:39) mentions:

Inclusion in the footnote shown under the previously quoted statement of the AA00 formula makes it clear



that the viewpoint of the subcommittee was that the question of liability for this portion of the loss is a legal problem to be resolved by the legislations or the administrative agencies.

The allowance for the deduction of compensation due to presbycusis varies from state to state in Northern America. The American Mutual Insurance Alliance includes in its manual four selected publications with different evaluations of hearing loss due to presbycusis (4:58).

1. The American Standard Association, 1954

Age	35	40	45	50	55	60	65
Average dB loss	0.6	2.6	4.3	6.0	8.3	10.7	13.0

2. Glorig, Grings and Summerfield, 1958

"Hearing loss in Industry"

Age	35	40	45	50	55	60	65
Average dB loss	2.0	3.3	4.5	6.3	8.0	10.0	12.0

3. Wisconsin State Fair Hearing Survey, 1954

Age	35	45	55	65
Average dB loss	4.0	6.3	7.2	15.6

4. Corso, 1963 "Age and Sex differences in

Pure-Tone Thresholds"

Age	34-40	43-49	51-57	59-65
Average dB loss	1.7	7.0	7.4	11.8

Standardization is not only an otological or compensation board problem, but also one for the acousticians. A basic question is:





Which standards have to be used in the measurement of noise, and which levels are safe?

Von Giercke (108) mentions:

Efforts are under way to arrive at international agreement on noise and vibration levels acceptable to man under various conditions, or if the time is not yet ripe for such agreement at least to arrive at standard methods for rating environments with respect to human exposure without attaching stigmas as 'hazardous' 'unacceptable' 'uncomfortable' etc. to the rating scheme. Obviously these latter attributes are not absolute qualities but are dependent on innumerable biological, psychological, sociological, economic and technological variables.

To what extent have the SHPr and researchers adapted the American Standard Association norms to the International Standard Organization units for their measuring devices? How many audiometers and noise level meters are used with the older standards? Why are articles still published using a variety of units for the same phenomena? Are conversion tables available to all EmHPr and IdHPr?

Which is the maximum of noise that the employer can make? A variety of damage risk criteria are used in Northern America. A review of the Wisconsin and Alberta regulations can be used as discussion material, because they differ and are considered as the most valid ones in the United States and Canada.

The Wisconsin 1962 regulations stipulate the following, concerning noise levels and the use of personal protection (63):

Properly fitted ear protectors shall be provided to persons who are exposed to sound pressure levels in excess of 100 dB for a major portion of their working day. Where the sound pressure levels exceed 120 dB, ear protection shall be provided regardless of the duration of such exposure. Excepted from this rule are those persons who for medically certified local ear conditions cannot wear such protectors.

The Alberta Provincial Board of Health Regulations of July,



1966 contain (1):

Where any person is required to work in noisy areas, where the sound pressure levels exceed the criteria set out in Figure one (here graph VII), the employer shall take appropriate measures to suppress such noise to the specified levels and, if it is not reasonably practicable to decrease the noise or to isolate the worker from the noise, the worker shall be supplied with and shall wear personal protection equipment which will effectively attenuate the noise to acceptable levels. Personal protective equipment required by this section shall be supplied at the employer's expense.

We are also reminded that European scientists consider 80 dB as the critical border for the safeguarding of human hearing (51).

Which are the discrepancies between the two above mentioned regulations? A major part of the day can be equalled to plus minus six hours a day for both states. The Wisconsin regulation advocates 100 dB as limit and a reading from the graph VII for the Alberta regulation is to be considered safe at 90 dB. A 100 dB exposure of the Wisconsin proposal corresponds on graph VII with 15 minutes per day in Alberta. The Alberta regulation is definitely safer. It also corresponds to the American Industrial Hygiene Association schemes. Is a difference of 10 decibel worth talking about?

Glorig (36) mentions:

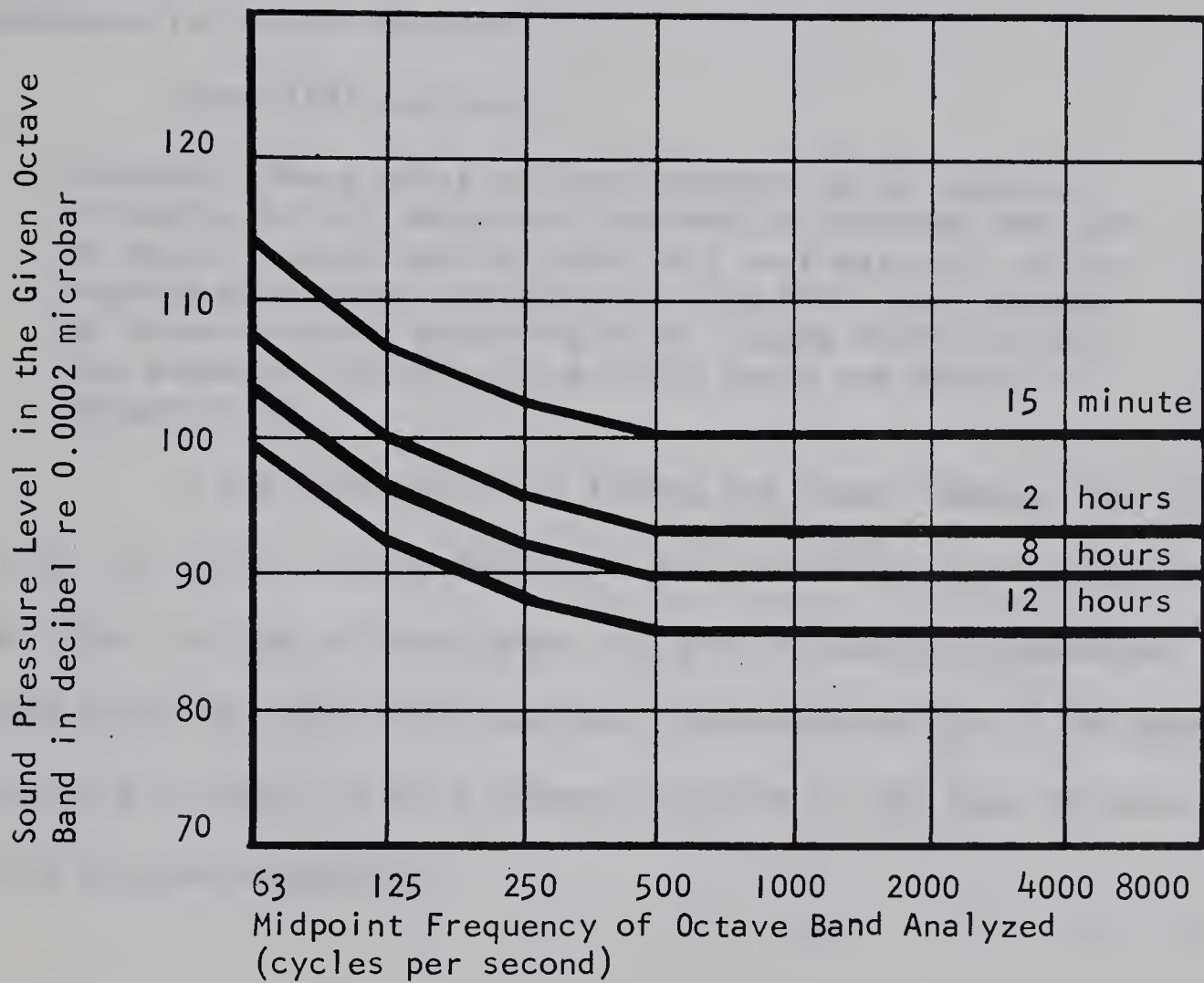
A survey by Karplus and Bonvallet shows that 50 per cent of machines used in American industry produce between 90 and 100 decibel of noise and 50 per cent of all areas measured showed noise levels between 85 and 95 dB.

Machines made according to the 100 dB limit of Wisconsin with a PONE of 90 dB and more are illegal in Alberta and in those states which apply the American Industrial Hygiene Association proposals. Compensation difficulties are inherent to a mobile labor force shifting from noisy jobs between 90 and 100 dB.





Maximum Per-  
missible Ex-  
posure without  
Protection  
(per day)



Contours showing the maximum sound pressure levels to which persons may be exposed each day for the given time periods.

graph VII

Regulations Respecting the Protection of Workers from the Effects of Noise in Alberta.





If 10 dB difference is of a minor value, why then can there not be uniformity in regulation in order to avoid administrative difficulties? Where is the clear-cut safety line? If 10 dB is that important, which are the valid grounds to support the difference? Why should a SHPr have to lose time in order to choose the right safety standards for his clientele?

Cohen (18) mentions:

Presently there exist various proposed noise exposure criteria, all of which are intended to minimize the risk of noise-induced hearing loss in a vast majority of the exposed population for their working life time. Several of these criteria governing five - eight hours continuous exposures to noise on a daily basis are shown in (graph VIII).

Is the SHPr policy of taking the lowest damage risk criterion for all cases a sound decision? The industrial associations have the right to look at the highest one and to consider themselves legally safe. The SHPr will lose much time and prestige if he cannot justify his selection of a safety criterion in the eyes of acoustically trained management.

## 5. Staff Utilization

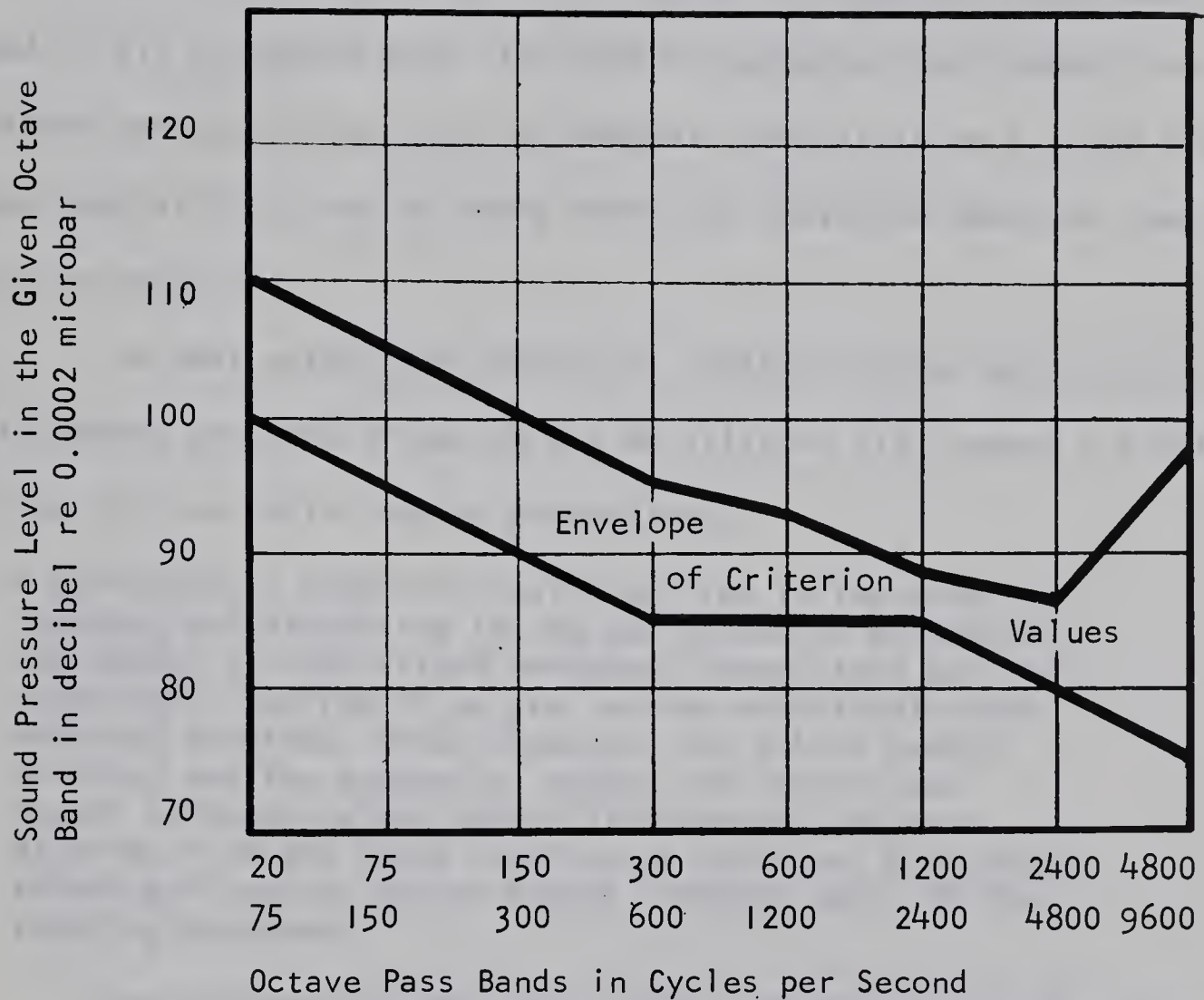
Which people belong to the health provider staff and how good are they, and which problems do they face in order to contribute effectively to the OD reduction?

Although the medical authorities usually claim the biggest share in the prevention programs, how well are they represented?

Maisel (72:60) states:

A recent count, including the three state labor depart-





Envelope of criterion values containing hearing conservation criteria developed by  
 Glorig  
 Hardy  
 Jones and Church  
 Kryter  
 Mc Grath  
 United States Air Force

graph VIII

Envelope of Damage Risk Criteria Compiled from Different Researchers by Cohen.





ment programs in Illinois, Massachusetts, and New York, reveals that a total of 484 employees are engaged specifically in occupational health services. It is significant, however, that about 80 per cent of these are engineers, chemists, physicists, or other non-medical workers, while only 20 per cent are nurses and physicians. Consequently, the preventive medical aspects of these programs frequently suffer.

To what extent suffering is to be considered by Maisel, is not mentioned in his following text. The lack of personnel can probably be explained because of the drain of medical specialists to a large range of new specialities such as space medicine, radiation medicine, pediatrics or geriatrics.

To what extent are industrial health sciences able to attract capable personnel? Charron and de Villiers (17) answer a similar question for the public health professions:

A particularly important challenge lies in the area of training and attracting to the public health professions the number of specialized personnel immediately and increasingly required if we are to cope effectively with existing problems. Often, however, the public health sciences and the aspects of safety and control are taught as separate and rather disconnected subjects, divorced from the basic teaching of medicine. Prevention, safety and control should become integral parts of the teaching programs.

The industrial health specialist should be given the right status. Maisel (72:182) brings the point forward in the employment setting:

It is necessary that the industrial physician be given a title and an authority that will lend him a full measure of prestige, both within the company he works for and within the medical profession as well. He must be given the good working condition and facilities that are essential to job satisfaction.

How efficiently is the HPr used? Siemens (100) discusses the debatable policy of different services for approximately the same work



on an EmHPr and SHPr level.

By a judicious redirection of current concepts of preventive public health services, a slight extension of our present horizons, and a modest relaxation of orthodox classification of fields of preventive health services these areas of "industrial" and "public" health services merge naturally.

The basic principles of personal and environmental preventive health measures apply equally to "public health" and "industrial health" services. Little re-orienting is necessary.

The extension of present health unit services is to include occupational hygiene as a natural part of a preventive health service.

There exists also an important loss of staff in red tape work and avoidable assignments. Siemens (100) reports in 1964 that from 66 occupational nurses in Alberta 32 are used in:

- City halls
- Hospitals
- Department stores
- Cancer societies
- Federal buildings
- Alcoholic foundations etc.

Jones and Cohen (53) mention:

Measuring noise levels in many situations and evaluating their potential hazard to persons exposed to it is difficult because few medical, engineering and other scientific personnel are qualified to evaluate noise problems. The apparent lack of concern extends even to public health workers.

Salaries are frequently too low to attract or hold needed medical laboratory and engineering personnel (72).

Taylor (106) states:

Lack of scientific knowledge and efficient control equipment is one of the chief handicaps which deters governmental agencies at all levels in their efforts to protect natural resources and human health.

A second need is coordination to bring together specialists in a wide variety of fields at the national, pro-





vincial, and municipal levels.

The lack of adequate recording, lack of knowledge and control are great in industry.

Charron and de Villiers (17) add:

There is an increasing need for a greater degree of application of the knowledge already available or gained from experience.

## 6. Management Viewpoints Related to Industrial Health

The EmEr is put on the spot for two reasons:

1) He is the person or the group of individuals who sanction and install harmful equipment.

2) There is a stigma on the EmEr for deliberate profit making by the use of unfair means. To some primitive minds 'Not being able to modify health hazards' equals 'Not willing to go along with social regulation.'

Brown (13:91) mentions in this regard:

In Great-Britain, we could not, even if we wished, ignore trade unions, we cannot ignore worker's long history of exploitation from the early days of the Industrial Revolution which has led to a tradition of bitter memories difficult to eradicate and therefore still operative.

The same author mentions that this stigma is not so obvious in other countries. The manager is pressed by:

Business associates

Tax representatives

Factory inspections

Union demands

Workmen's compensation board regulations





Health and welfare agencies

Trade

Equipment renewal

Maintenance

Investment

Employee absenteeism and turnover

There are also elements like family responsibility, religion and philosophy, education and tradition, status, sensibility to ethics encroachment, etc.

How do business standards of right or wrong differ from prevailing traditions of morality in the modern society? Carr (16) points out some ethical business attitudes underlying practices which are considered as unfair by society.

We live in what is probably the most competitive of the world's civilized societies. Our customs encourage a high degree of aggression in the individual's striving for success. Business is our main area of competition and it has been ritualized into a game of strategy. The basic rules of the game have been set by the government, which attempts to detect and punish business frauds. But as long as a company does not transgress the rules of the game set by the law, it has the legal right to shape its strategy without reference to anything but its profits ...

A wise business man will not seek advantage to the point where he generates dangerous hostility among employees, competitors, customers, government or public at large. But decisions in this area are, in the final test, decisions of strategy, not ethics.

If an executive allows himself to be torn between the decision based on his private ethical code and one based on business considerations, he exposes himself to a grave psychological strain.

A business strategist's decisions must be impersonal as those of a surgeon performing an operation concentrating on objective and technique, and subordinately personal feelings.



Is it right that a manager reduces noise, not for the good health of his workers, but in order to avoid more complaints and a loss of good will among employees? Carr mentions further that if the laws governing business change, or public opinion becomes clamorous, the manager will make the necessary adjustments. As long as they comply with the letter of the law, they are within their rights to operate their business as they see it. The management's viewpoint is not to promote ethics.

The last century is characterized by important social changes in the industrial setting where the pendulum is swaying from extreme worker's exploitation to considerable pressures on the management. Porter and Lawler (86) sketch the management viewpoints of the early decades of this century:

... during the early part of this century, the focus was on the principles of scientific management with their concern for maximizing operation efficiency. And since these principles were based around the 'man as a machine' analogy, and since machines obviously do not have attitudes it was logical for companies to ignore job attitudes in their search for new approaches to increased human efficiency.

Undoubtedly there are still traditional attitudes feeding unsocial mentalities in management. A thorough historical study in this scope could actually reveal underlying causes of employers' attitudes to PONE mitigation.

Some of the employer's main incentives for occupational health programs are according to Platt (85), Hazen, Roberts and Young (43), the Institute for Social Research, University of Michigan (50):

Reduction of absenteeism

Reduction of labor turnover







Reduction of retraining costs

Reduction of time losses on the job

Superior morale

Rise of production

Maintaining reputation among competitors and customers

The employer has not always a strong active interest in health prevention especially when he feels that the public image is maintained better through welfare, recreation, fringe benefits, health agency supports, or other spectacular contributions.

Maisel (72:24) further notes:

When managers look around for a yardstick of how well they are living up to their responsibilities they tend to look around at other managements of the same industry. They do not measure themselves in their performance against some abstract notion of what a management should be and should do. But they do look to their own trade associations and to people they know in the same industries as themselves, and they decide they are doing adequately or inadequately in terms of what they see in their own industrial line.

An EmEr even feels it as justified in altering safety precautions. Kellogg (56) quotes:

When an organization is in great need of employees, management commonly feels justified in assuming a potential increase in compensation liability through the lowering of the standards approval, rather than suffer the shortage of employees.

The EmEr is also caught in a vicious circle. He has to make a choice of the equipment which he will buy and which has to satisfy his immediate need, i.e., good production. On the one hand he claims that the noise is largely out of his control and could be reduced satisfactorily only by the manufacturer. The latter, on the other hand, raises the objection that there is little demand from his customers



for quieter equipment (20:99). There are also disagreements between designers, acousticians and the manufacturers (102).

Without regulation, competitive pressures in both the manufacturing and the operating industries, are unlikely to reduce the OD hazard (12). The Committee on the Problem of Noise comments in the Final Report (20) that the vicious circle has to be broken by the customers. If they ask for quieter machines, the manufacturers will be obliged to supply them. The vicious circle also exists on the large public basis. The Committee on the Problem of Noise (20) mentions:

If quietness were more sought after by the public in domestic and industrial machinery, we have little doubt that the demand would in time be met.

Also the employer is hardly willing to accept that there are noise problems. The World Health Organization quotes in an editorial (111):

Many employers may fear litigation or legislation if they agree to investigation of the problem.

Maas (64) mentions:

There are still many companies that will not organize hearing conservation programs because of fear of initiating claims.

Glorig (36) states in 1961:

The attitude of most industrial leaders 15 years ago and even five years ago was, to say at least, conservative. Few wished to install a conservation of hearing program for fear that the institution of the necessary procedures would emphasize that hearing loss due to industrial noise was a compensable condition in many states. It was clearly a case of let sleeping dogs lie.

The problem contains also a time factor, disadvantageous to the EmEr. Maas (64) mentions:

The last employer should be liable for the entire occupational deafness to which employment has contributed,





but if previous deafness is established by a hearing test or any other competent evidence, he should not be liable for the previous loss so established.

However, the reality is, that many employments have people exposed to PONE who had serious OD previous to the enactment of the protective laws. This means that they have not violated the law previous to its enactment. There is also the lack of a valid audiometric reading during the technical development of audiometry. A yet unknown number of employers will find themselves as the last employer. Many employers take a waiting attitude.

Sataloff (91:299) states:

Undoubtedly there are large industries that will find themselves extensively involved with industrial deafness. Some of these plants may already have medico-legal problems because of claims for occupational deafness. Others may be waiting anxiously to see what happens about such matters in courts or legislatures of their respective states or to learn how similar problems are handled elsewhere.

Which are the usual arguments of the EmEr towards personal hearing protection? Maas (71) mentions some causes brought forward by engineers and nurses who work in noisy plants:

Most managements take the ostrich attitude toward the noise problem.

Management fails to sell employees on the need and value of ear protection.

Management is afraid. Management will not admit it has a problem until specific laws are passed.

Reluctance of management to support hearing conservation measures because of bad experience with other protective equipment.

Failure of management to follow through once the program is started.

Complete lack of interest in management as other problems are more pressing and need immediate attention since this





problem has results or implications which are far in the future.

The cost of cases is too small now to get excited about the problem.

It is easy to get initial interest which dies down shortly, and this is very hard to arouse again.

The program was given a very poor introduction, which fell flat.

No single person has been assigned responsibility of seeing that the program is made to work.

We do not think our plant is noisy like other plants.

## 7. Cost of Occupational Deafness Mitigation to the Employer

The financial strain on the EmEr is heavy because he has to pay noise surveys, modification of PONE to safe levels, compensation premiums, and OD prevention education. Although the EmEr can add the cost to the price of the product to be paid by the consumer, he does not abide by this rule. Salary comprises a considerable part of the occupational health service. The Bureau of Business Research of the University of Michigan estimates that salary costs usually comprise 65 to 75 per cent of the total costs of the service (50:34). The large plants are better off than the small plants because they can afford private consultants. The latter should be freely available through government services, as is proposed by the World Health Organization (111). The larger plant may be able to use the services of a regular doctor or nurse. In a small plant there is not as much work to be done. The potential value of full time personnel may be greater, since they have more time to become fully informed of conditions and people in



the plant.

The small plant owner has generally a high potential presence of occupational health hazards.

Maisel (72:31) states:

That the employees of such smaller plants are in need of the health protection of industrial medical programs is evidenced by numerous indices. The accident frequency rate, runs two-and-a-half times as high in small industry as in large. Absenteeism due to illness shows similar - although by no means as great - difference to the disfavor of smaller work places.

Are the small plants disappearing? Apparently not, because Fredrick, Director of the Bureau of Industrial Hygiene, Detroit Department of Health (72:31) mentions:

Recent surveys indicate that small businesses are on the increase. Employees of small businesses today, represent approximately two thirds of our entire labor force.

There are some false ideas about large concerns. Fredrick (72:31) mentions that Detroit in 1959, which is popularly thought as the citadel of large scale industry, has 815,000 workers in 42,250 workplaces. The average number of workers per workplace is under 20; the median of workers per workplace is eight. About 41,000 of Detroit's workplaces has four to 25 employees. On the premise that OD prevention is not highly ranked on the occupational disease list by the workers and the managements, there are probably a small number of Detroit workers who never get in touch with OD prevention. The small employer has to use second hand methods to evaluate noise levels and hearing loss, such as the spoken voice technique.

What are some of the financial pressures on the small employer? Robertson (72:32) quotes:







The typical small plant executive is faced daily with problems that must be handled immediately - capital needs, union negotiation, sales, production, taxes, etc. He has limited staff and thus must handle many of these problems himself, leaving him little planning time for the acute production problems, much less long range thinking about employees health. To convince him of the value of an industrial health program is frequently difficult because his records often do not indicate some of the real costs of 'not' having such a program, such as absenteeism, turnover of labor, accident compensation, etc.

They find it extremely difficult to anticipate the cost of a proposed program - since so few of their counterparts in small industry have experience records available - equally difficult to even estimate such costs on the basis of comparable experiences among firms of their own size and type.

The same absence of comparable experience data leaves among small plant executives even more dubious about the savings that might offset the costs of a worthwhile industrial health program.

The first question asked by small employers are generally, "How much absenteeism will go down?" and "How much will the compensation costs decrease and what percentage of productivity gain is to expect?"

#### 8. The Relationship in the Plant between the Employer and the Health Provider

The efficiency of the in-plant health services is a function of the EmEr contribution, of the EmHPr knowledge about PONE and OD and his enthusiasm, of the in-plant climate between the management, the workers, and the health services. Hazen, Roberts and Young (43) state that the plant representatives must have a basic interest in health and the time, enthusiasm, ingenuity, and sincere desire to participate in the health program. The EmEr can freeze or encourage a health pro-



gram and occasionally industrial management seems neither fully to understand nor to be interested in the planning of employee health programs (43). Maisel (72) mentions that management which does not have employee health services and which are going to install them, are going to make them adequate only insofar as that responsibility is undertaken by the industrial physicians themselves.

Wade and Maisel (72:232) mention:

Management is too often unclear as to what it expects of the medical department; and, by and large, management has not learned to use the physician and his assistances efficiently in their plants.

Maisel (72:232) further comments:

If top management treats its medical personnel as mere technicians and relegates their work to inadequate and ill-appearing quarters, intermediate management, supervisors, and line workers will accord the department no better status and its potentialities will seldom be attained.

The use of the health services as a kind of maintenance service or emergency unit can lower the EmHPr prestige. The EmHPr needs access to all parts of industry and the time to learn more about the people, their work places, their attitudes, their reactions and their personal problems. This approach can enable him to do a better job of consultation on the physical and environmental factors, such as that of light, noise, air-condition, etc. Also the EmEr has to allow the EmHPr to get access to the necessary periodicals, conventions and instructional means.

Fleming, D'Alonzo and Zapp (30) have set up some of the basic questions to be answered by both, management and the plant physician. These questions are adapted to the OD prevention.





Questions to the Employment Employer

- 1) Do you understand and properly estimate the value of adequate OD Prevention?
- 2) Is the money spent on OD prevention worthwhile?
- 3) Do you have allocated adequate space for your audiometric and prevention facilities?
- 4) Has the EmHPr the necessary facilities and equipment?
- 5) Do you have sufficient EmHPr staff to control OD?
- 6) Is the salary of your EmHPr staff comparable to its status groups?
- 7) Is the EmHPr considered as regular staff?
- 8) Do you allow your EmHPr to increase knowledge at your expense?

Questions to the Employment Health Provider

Some of the following questions are specific to the physician.

- 1) Do you make frequent inspection trips in order to find PONE sources and OD threatened personnel?
- 2) Do you consider or suggest shifts for IdEes with OD?
- 3) Are you familiar with the physical and mental requirements of every job with PONE?
- 4) Do you consider the prospective IdEe with possible OD with regard to his influence on fellow IdEes, equipment and production?
- 5) Do you make periodical hearing examinations of the IdEe in order to find out the earliest symptoms of OD that may arise in the plant?
- 6) Do you keep audiometric records of the IdEe?





- 7) Do you have time to listen and to evaluate emotional disturbances of your employees?
- 8) Do you improve your personal knowledge about the OD hazard and its consequences?

The impression may rise that the management is the guilty element of the EmEr-EmHPr duet. The opposite is also true.

Maisel (72:177) states:

Many a firm which has seriously planned starting a program for the protection of its employees has had to delay putting it into operation, because of an inability to find suitable staff personnel.

Many another program has deeply disappointed its sponsors because the physician or nurse hired to direct it has lacked an adequate understanding of its goals or sufficient knowledge of the techniques of occupational health work.

## 9. The Management - Labor Force Relationship

Does the EmEr want contacts with the EmEe?

Friedlander (31) mentions:

Company attitudes and policies are established by top management and this pattern then represents the formulated "thinking" of the company at all levels. Deviations are seldom permitted.

Tannenbaum (105:84) explains the reluctance of the EmEr to contact the EmEe in the large concerns:

There are numbers of reasons why managers oppose a more participative role by workers, whether through unions or as part of a more participative organizational system.

Traditional management makes no provision for worker responsibility or initiative.

Most managers maintain that organization members are incapable of leadership and that they prefer to be directed and avoid responsibility.



Managers fear that control by workers leads to chaos.

Managers prefer personally to be in a position of control, and they are likely to think that control by workers threatens their own power and hence their self-interest.

The greater the formal character of the management, the less are the chances for adequate communication.

Brown (13:101) states:

Since all the information from the lower levels deals ostensibly with technical matters relating to production, there tends to be defective communication between workers and management so far as human problems and grievances are concerned. In reality, of course, a great deal of information concerning personal matters passes both up and down in the form of gossip, but this, being unofficial, cannot, or should, not be acted on.

One of the main functions of Joint Consultation Committees is to deal with such matters as well as with the more technical difficulties which arise from time to time, but unless the atmosphere of the factory is good and a degree of mutual respect already exists such committees are likely to prove dreary sessions during which the workers' representatives rack their minds to produce all sorts of petty complaints but never get down to any serious ones. The committee will be told that there was no soap in such and such a lavatory last week, that the "Music while you work" was cut off five minutes too soon the day before yesterday ...

Brown further mentions that, when a sense of fear and insecurity pervades a firm, and workers are scared of being victimized, no complaints other than trivial and formal ones, relating to matters of detail, will ever reach the management.

Do the workers have capable representatives at the joint consultation boards? The problem is even more difficult to defend the desire to get noise eliminated, especially when the arguments are lacking because of insufficient insight of the effects of noise on the personal and social life of the worker. Brown (13:297) describes how







workers are performing badly when they are demanded to bring forward their viewpoints in an authoritarian industrial setting.

To begin with, workers are asked to elect their representatives and, of course, nothing happens. The workers, having been given no responsibility in the past, show none when the opportunity is offered them. So management, secretly pleased that their belief in the irresponsibility of the workers has been thus confirmed, proceed to nominate members for the council. But the council that has been formed in this way shows no trace of 'joint consultation'. Nothing is discussed and the workers' representatives do little but produce minor and relatively safe grumbles of the sort already mentioned elsewhere. (see above)

The same author mentions that joint consultation can only work in an atmosphere of mutual trust, or at least in a situation in which management intentions are not entirely suspect.

Glorig (36) states:

I have encountered unfavorable attitudes of employers and employees that are based not on the health benefits involved but on some management-labor problems which have no relation to hearing conservation.

The opposite of Glorig's statement is also true, i.e., that managers do not want to introduce the use of personal hearing protection, because they know that the workers will oppose it.

What is the influence of the presence of a union in a plant?

The Institute of Social Research (50) points out that 48 per cent of employments with unions have employee health services. Only 28 per cent of employments without union establishment have employee health services. The authors remark that the presence of the union makes the EmEr more aware of employee relations and hence, he is more likely to engage in activities in the health field.

Maisel mentions that unions have been opposed to, or little in favor of the medical contribution, for fear of making the worker



perform more. Management has to ensure unions that results of examinations will be handled in confidence and not to exploit the worker potential.

The Canada Department of Labour (15) states:

The Workmen's Compensation Commission realizes that a future increase in claims is to be expected once the labor unions get the information through to the workers.

Has Labor exerted much influence to encourage the formation of noise control programs? Sataloff (94) answers this question:

No. Its influence has been minimal. Some unions appear to have done preliminary research in this area but none has given noise control a solid, sustained promotional push ...

#### 10. The Individual Health Provider Contribution

The IdHPr is a key person in the OD prevention. His position and action is the resultant of a number of factors such as:

##### The Management - Labor Climate

Brown (13:153) illustrates the IdHPr position in an industrial setting with varying climate:

... the factory physician in a problem factory will find that he is no longer regarded as someone who is out to help others, regardless of their official status or whether they are considered as good or bad workers, but rather as a supporter of the hated management. This may be so even when he is himself regarded by management with suspicion as being too progressive or democratic. Thus a doctor who has had the interesting experience of working in more than one firm may find that, although he treats all his patients in all of the factories in the same way, in one firm he is regarded with affection and trust whereas in another he is looked on with suspicion and resentment. In short, the way he is regarded by the employees does not depend solely, as is so often thought, upon his personal qualities as an individual; on the contrary, it tends to be a function of the atmosphere obtaining in the firm.





### The Nature of the Health Program

Not all health education programs are the same. For instance, a "Better Nutrition" propagation differs from the OD prevention program. The proposal for more balanced food does not hurt the EmEr, but OD reduction can be felt as an open accusation that the workplace is harmful. This latter fact puts the EmEr on the defensive, and his action may be one of contribution without enthusiasm. The EmHPr who proposes OD mitigation has only suspicions but no facts. These can only be confirmed after noise surveys and audiometric readings have been performed.

### Priority to Health Services Other than Hearing Prevention

The smaller the employment is, the more varied will be the service to be rendered by the IdHPr. He has to be competent, not only in OD and noise, but also in other hazards and their consequences. He may not only prefer to handle certain types of diseases, he may be forced to treat the spectacular ones and the apparent needs in the plant. When cuts and bruises are frequent problems, it is acceptable to suppose the HPr to spend most of the time on their prevention.

### Quality of the Individual Health Provider

The International Labor Office-World Health Organization in the Geneva Symposium of 1963 emphasizes (10):

The medical inspector should have sufficient knowledge of the hazards which can be associated with environmental conditions, including noise.

Maisel (72:36) quotes:

To a great many, probably the majority, of the doctors and nurses today, industrial medicine means simply the care of industrial injuries.

The duties required of the IdHPr in the industrial setting have been





underlined in the above sections by Fleming, D'Alonzo and Zapp (30).

## 11. Interpretation of the Work Condition

To what extent are work conditions evaluated by the workers and the employers, compared to other factors such as job security, wages, discipline, etc. An editorial in the Personnel Journal (6) compares a set of factors evaluated both by management and labor force. See table VII. These data have to be interpreted with care because no quantitative data are included. Support, however, can be given through a number of statements.

Sutermeister (104:11) mentions:

Working conditions can of course affect the employee's comfort at work, but many are the examples of employees working under bad working conditions who have a high level of morale and likewise, the employees working under the best physical working conditions who have a low morale.

Brown (13:192) mentions:

... the observer has only to look around him to see that, however desirable good working conditions in the material sense may be, they have little or no direct relationship to good morale. It ought to be abundantly clear that bad conditions of work in themselves have practically no bearing at all on the morale of the workers or their attitude to the job.

The same author states further (13:194):

It need hardly be said that this is not a plea for bad working conditions, or an attempt to deny that the physical environment is of the utmost importance and that bad conditions adversely influence health and happiness. But there can be no doubt that good physical conditions may coexist with bad morale, and bad conditions with good morale.

We constantly read, for example, that increasing illumination by X per cent raised production by Y per cent, or, to take a specific instance, that wearing earplugs in a



EmEr Evaluation	Involved factors	IdEe Evaluation
1	Good wages	5
2	Job security	4
3	Promotion and Growth in company	7
4	Good working conditions	9
5	Interesting work	6
6	Personal loyalty to workers	8
7	Tactful disciplining	10
8	Full appreciation of work done	1
9	Sympathetic help on per- sonal problems	3
10	Feeling "in" on things	2

table VII

Evaluation of Factors Related to the Employment by the EmEr and by the Labor Force.





noisy weaving factory increased production by 3 per cent. The validity of the figures given is not in doubt, but what it was that caused production to be raised or absenteeism lowered is quite another matter.

Besides the impact on the hearing, does noise impose a health hazard? This question is difficult to answer, because there are several schools of thought. For example, the Max Planck Institute researchers, like Jansen, Lehmann, and others, have published evidence of impact on physiological conditions. However, Glorig (36) mentions:

Despite ignorance of the quantitative nature of non-auditory effects of noise, enough is known to conclude that the effects of noise encountered under industrial conditions do not produce a health problem. Many employees work under noisy conditions for many years and show no general health changes that can be said to be related causally to noise exposure

How does the worker view excessive occupational noise? The industrially employed population exposed to noise on the job is far from a homogeneous group. The type of workers includes highly skilled and formally educated personnel as well as the semi-skilled or unskilled labor force. The lower income bracket group contains jack hammer operators, road constructors, and farmer aids. There is little information available about the interpretation of noise by different social groups. Stramentov (102) mentions that noise is suggestive of power to the uneducated worker. A machine which operates silently or without vibration is obviously far less impressive than a noisy one. Some people still imagine that the more noise there is, the more work is being done. Noise acts as an ego-relevant factor. It makes the operator of the power tool feel superior to fellow workers. This attitude is frequent among boilermakers, army men, tractor drivers, etc. In the past, boilermakers have been proud of their deafness. It has



been considered as a sign of proficiency (91).

Hoegger (47) states:

Lorsqu'on s'entretient avec des ouvriers, on est souvent étonné de constater leur indifférence complète envers le bruit. Même ceux qui travaillent dans des industries très bruyantes semblent s'y adapter sans plainte et sans que leur santé paraisse en souffrir beaucoup.

On voit qu'il faut plus de 100 dB pour que la plupart des ouvriers se déclarent gênés par le bruit. Si l'intensité est de 90 dB et empêche donc de façon notable la conversation, la plupart des ouvriers y restent indifférents... Il ne faut pas oublier que les ouvriers travaillant dans les industries bruyantes, sont précisément ceux qui tolèrent le bruit facilement; un certain nombre de sujets qui ne peuvent pas supporter le tintamarre des usines les quittent pour choisir une autre profession.

The author mentions that workers are not bothered by noise levels which do not surpass 100 dB and even if the noise is 90 dB and if conversation is interfered, they do not feel annoyed. He further mentions that the workers who stay on noisy jobs are the ones who are not bothered by noise; the others look for new jobs. Buchwald (14) supports the last statement.

The exposure to the noise hazard may be so obvious that the workers are perfectly familiar with it and minimize the danger (72:70). One has to remember that OD sets in slowly and that the adaptation is easy.

Katz (55) mentions:

Unsatisfactory pressure, temperature and humidity, illumination, and noise levels are often ignored because they appear to be arousing only nuisance and discomfort.

The Committee on the Problem of Noise (20:5) states in the Final Report that the public in general is not opposed to noise, except if it is excessive.





A noise nuisance has to be great before people will take it upon themselves to make a formal complaint to a local authority, the police or a magistrate.

## 12. Resistance of the Individual Employee to Occupational Deafness

### Prevention

What keeps the individual employee from reporting to the IdHPr, to the EmHPr and to higher authorities? Some factors are discussed, but they still need more evidence.

### Group Security

Brown, Tannenbaum, Herzberg, and other authors, mention that the rewards which the IdEe gets from his job are social, such as respect from fellow workers, admiration and friendship. Even under working conditions which are far from satisfactory, most workers like their employment. This is because workers are quickly integrated in primary groups, in which they become participating members. There, they find understanding and support for home and job problems, or for personal difficulties. The workers are bound together by common sentiments of feelings and loyalty. Evidence has still to be gained to what extent job loyalty prevails the desire to leave the job because of excessive noise. The longer a worker is associated with the plant and is used to its routines and customs, the more he becomes stable, reliable and conscientious (101).

## Resistance to Admitting Hearing Insufficiency and Health Behavior

### Deterrents

Pflanz, Pinding, Armbuester and Toeroek (84) mention:





Ehe ein Patient zum Arzt kommt, hat er seine "Selbst-diagnose" gestellt, ob eine bestimmte Empfindung oder ein Ereignis als "Symptom" aufzufassen sind, er hat einige Entscheidungen im Rahmen des Laiensystems getroffen, und erst am Ende einer Vielzahl verschiedener Schritte steht der Gang zum Arzt.

Hierbei spielen zweifellos individuelle Erfahrungen, Persönlichkeitsmerkmale und tiefliegende Motivationen eine Rolle, aber auch kulturelle Wertvorstellungen, Gebräuche, Sitten und gruppenspezifische Gewohnheiten und Anschauungen.

The author mentions that the patient has made his self-diagnosis before he goes to the doctor. Individual experiences, personality characteristics and motivations play an important role, as well as cultural interpretations, habits, traditions and group specific points of view.

The National Education Association (78) states:

Health behavior is almost exclusively a product of culture in which he lives. As persons grow older and begin to gain information and think for themselves, weigh scientific evidence, and modify their cultural backgrounds, they may begin consciously to choose different ways of behaving. However, health behavior grounded in family, cultural and ethic patterns tend to persist. This makes the effort to change undesirable health behavior patterns of individuals and groups a difficult and often disappointing process.

"Manliness" requires that the affected person disclaims any pain and minimizes or even hides his injury. An employee holding this belief cannot conceive of serious consequences in terms of his own behavior. He may visualize unhappy results for others from lack of care, but not for himself (78).

Which are the underlying conflicts when a worker refuses O.D. prevention on grounds that he did not wear hearing protectors all the years he had worked with the company and he is not starting now (42)? Is it fear, false pretension, or lack of self-criticism?



Most workers are completely uninformed about routine hearing checks and may have a fear of pain in the examination or an inbred dread of what may be found in the examination (72). The climate in the plant must be such that the IdEe can retain his manliness and report his suspected hearing loss.

Greenhill (41) mentions:

The success of any occupational health programme will depend ... on the employee's realization that the medical department respects personal privacy and the confidential nature of medical records. Once employees realize the medical department's professional competency; its respect for confidential discussions; its open door policy and non-judgemental approach, the occupational health programme will be effective.

Barker (8) mentions:

If a hearing program is to be undertaken, the purpose of it must be explained to the workers concerned; otherwise it will be regarded as a fuss about nothing and the attitude of 'what was good enough for my father is good enough for me' will prevent the full use being made of safeguards provided.

### The Use of Personal Hearing Protection by the Worker

Earplugs and earmuffs have to be used in noisy environments when PONE cannot be reduced by means of insulation or redesigned equipment. Beales (9) mentions:

There is a great deal of resistance from the employee to wear protecting devices when the noise is not intense enough to cause pain in the ears.

An extreme example is as Maas reports:

I can also report instances of employees cutting the plug in two, leaving the surface or outside of the plug exposed for checking purposes by supervisors.

Williamson (110) notes:

There is rarely any difficulty in persuading workers to wear protection if they are exposed to very high noise levels, for the use then prevents pain.







Maas (66) mentions some objections by workers:

Earplugs hurt and are uncomfortable,  
 Earplugs are too much bother and get lost,  
 Earplugs are a nuisance and an inconvenience,  
 Earplugs cause headaches and make one nervous,  
 One cannot hear the sounds of the machines to check their  
 operation properly,  
 One soon gets used to the noise and it really does not  
 bother one too much.

How do workers react to earmuffs? In general, workers and managers like earmuffs better than the earplugs, although there are some remarks, such as:

Earmuffs are no good in hot weather or inside in paper machine rooms (66).  
 They are too tight and press the head uncomfortably (71).  
 The earmuff is bulky and many a potential ear muff wearer has been kidded or laughed at to the point where he tossed them aside although he really liked them for the comfort that he experienced (66).

### Claiming Difficulties to Be Faced

The individual employee has already faced frustrations and insecurity before he decides to file a claim. The reasons have been mentioned in chapter II. Following are some of the compensation troubles.

a) First of all, the employee is dependent on the type of protective state legislation. If there is no compensation possible on a legal basis, the employee will have to be backed by strong support of unions, lawyers, and other influential people. The American Mutual Insurance Alliance (4:41) states that in 1964 compensable OD exists in more than half of the states of the United States. What happens in the other half? Differences in terminology have already been explained in previous sections.

b) The worker will have to prove that he has been free from



outside the job noise exposures, such as, from rifle shooting, or from extra work for another employer. Employers are reluctant to accept the responsibility for hearing loss which may be due to non-occupational causes (4).

Maas (64) notes:

Compensation boards do not recognize mild degrees of deafness. Only when the average threshold shift in speech frequencies in the better ear is increased by 25 dB or more, is the condition considered compensable. At this level an individual begins to experience difficulties in single or group conversations even in a small room.

c) The worker will have to present a kind of pre-employment hearing evaluation although some legislations make the last EmEr liable for the whole amount of deafness acquired.

d) It is important that the worker remains away from noise, which presumably is causing OD, for at least six months before final hearing evaluation can be made. Another reason for the waiting period is that claims have to be spread over a time.

The American Mutual Insurance Alliance (4:4) mentions:

If all workers with some degree of hearing loss or impairment were free to file claims for compensation at any desired time, the result could be a mass influx of claims with chaotic results.

Workers do not like to take action when they are not backed by unions, lawyers or influential persons. They do not claim for fear of jeopardizing their employment. They fear to be downgraded, earn less, or fail promotion (111).





## CHAPTER VI

### COMMUNICATION BETWEEN THE STATE HEALTH PROVIDER AND THE INDIVIDUAL EMPLOYEE

The quality of the occupational deafness prevention information received by the individual employee from the state health provider is function of three basic factors.

- 1) Complexity of the channel, this means the number of intermediates used between the state health provider and the individual employee.

- 2) Methods used to pass information.

- 3) Effects within each intermediate, i.e.,

Receptivity of each intermediate, i.e., acceptance or rejection,

Transformation of the received material, i.e., contamination, loss, addition,

Delay in transmission of the information.

#### 1. Variety of Channels between State Health Provider and Individual Employee

The IdEe change of attitude and behavior towards OD prevention depends on the variety of stimuli which he receives from his environment, i.e., his fellow workers, social workers, medical advisers, inside and outside the plant and indirectly the SHPr. The National





Education Association mentions (78):

Health problems are so closely intertwined with social problems that the two can hardly be considered or treated separately.

An important part of the SHPr activity is to send out material to the IdEe. This can happen over a number of adequate channels in the hope that the information which has to be received is still valid. A second part of the SHPr activity is to adapt the information to the level of the IdEe. The understanding of the workers' social status is therefore important. Elton Mayo (13:110), well known in industrial sociology because of his involvement in the Hawthorne studies, mentions:

I believe that social study should begin with careful observation of what may be described as communication. This problem is beyond all doubt the outstanding defect that civilization is facing today.

So far, there is little information available about the quality of the communication channels used between the state health provider and the individual employee. The various channels between these two extremes have to be broken down into basic two-way communication units. The various units are represented in figures X, XI and XII. There are three types:

- 1) Type I contacts, which all include the starting point, i.e., the state health provider. These contacts are initial.
- 2) Type II contacts, which are intermediates but do not include the state health provider and the individual employee.
- 3) Type III contacts, which all include the end point, i.e., the individual employee. These contacts are terminal.



The Type I Contacts

State Health Provider - Employment Health Provider	SHPr-EmHPr
State Health Provider - Individual Health Provider	SHPr-IdHPr
State Health Provider - State Employer	SHPr-SEr
State Health Provider - Employment Employer	SHPr-EmEr
State Health Provider - State Employee	SHPr-SEe
State Health Provider - Employment Employee	SHPr-EmEe
State Health Provider - Individual Employee	SHPr-IdEe

The Type II Contacts

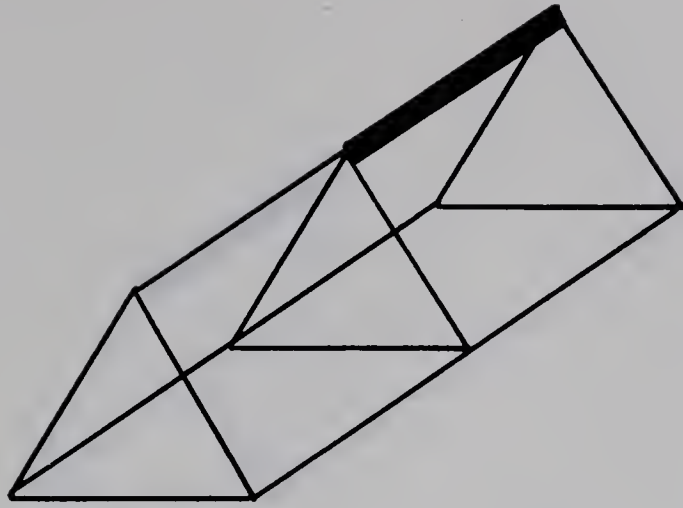
Employment Health Provider - Individual Health Provider	EmHPr-IdHPr
Employment Health Provider - Employment Employer	EmHPr-EmEr
Employment Health Provider - Individual Employer	EmHPr-IdEr
Employment Health Provider - Employment Employee	EmHPr-EmEe
State Employer - Employment Employer	SEr-EmEr
Employment Employer - Employment Employee	EmEr-EmEe
State Employer - State Employee	SEr-SEe
State Employee - Employment Employee	SEe-EmEe
Employment Employer - Individual Employer	EmEr-IdEr
Individual Health Provider - Individual Employer	IdHPr-IdEr

The Type III Contacts

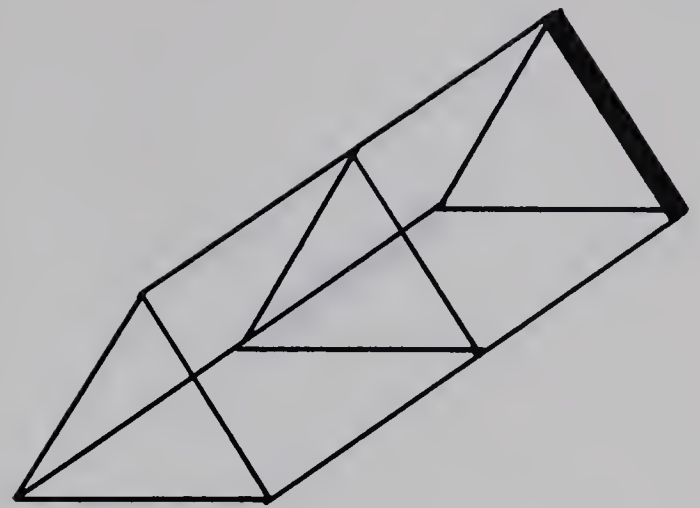
Employment Health Provider - Individual Employee	EmHPr-IdEe
Individual Health Provider - Individual Employee	IdHPr-IdEe
Employment Employer - Individual Employee	EmEr-IdEe
Individual Employer - Individual Employee	IdEr-IdEe
State Employee - Individual Employee	SEe-IdEe
Employment Employee - Individual Employee	EmEe-IdEe



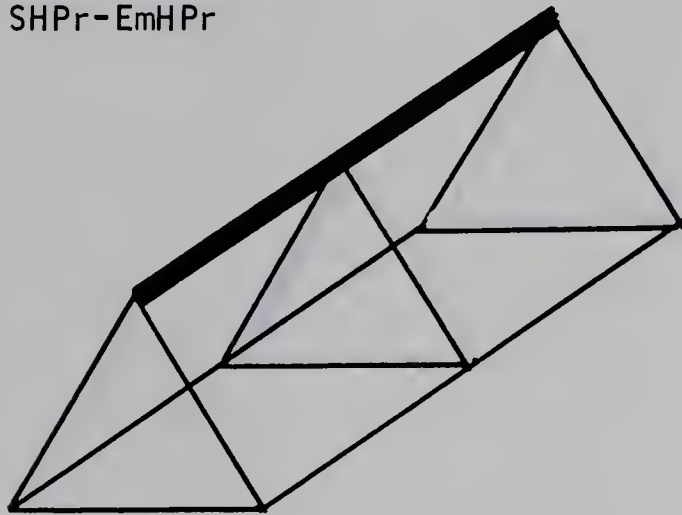




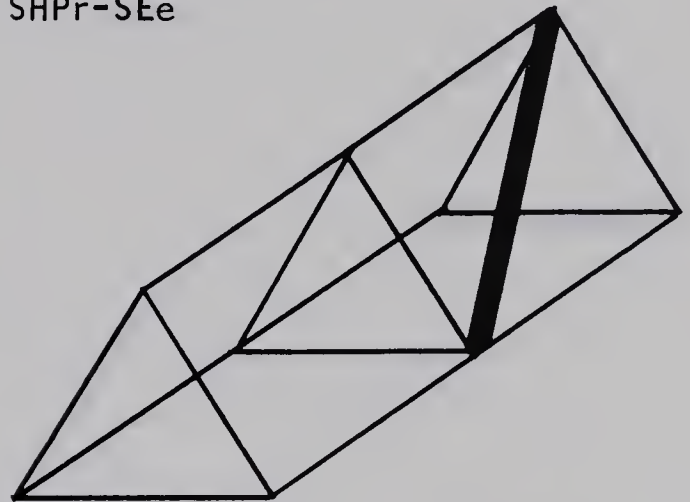
SHPr-EmHPr



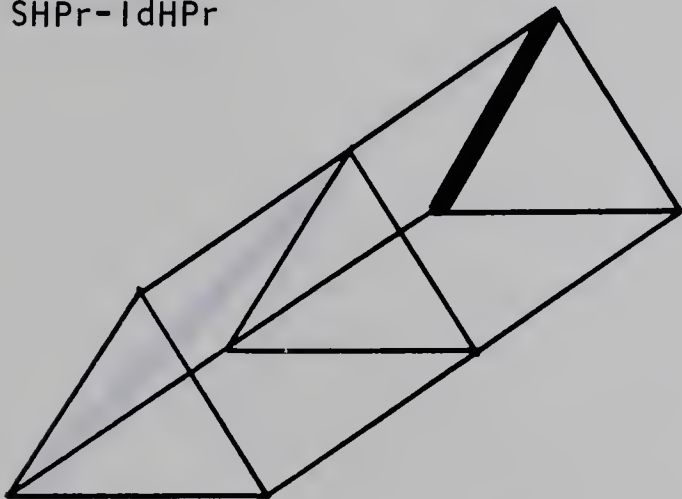
SHPr-SEe



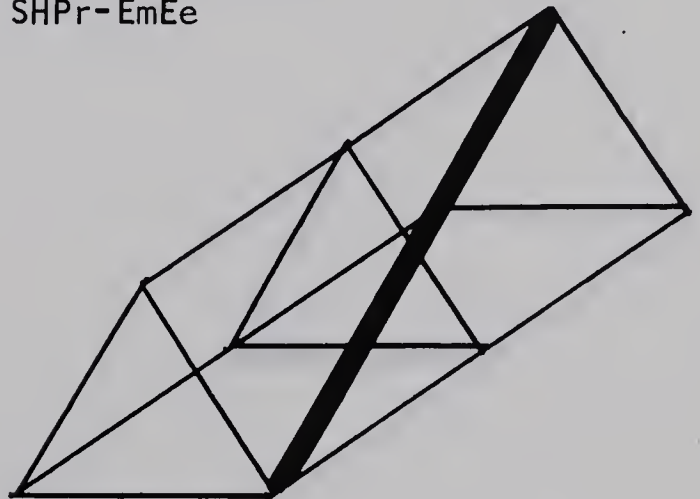
SHPr-IdHPr



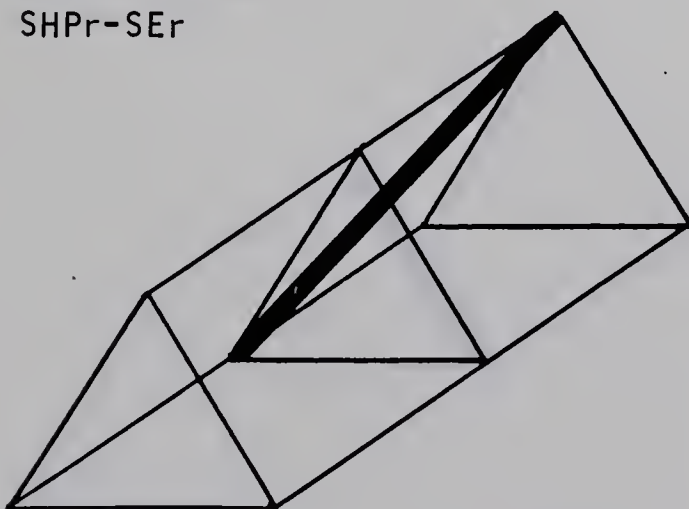
SHPr-EmEe



SHPr-SEr



SHPr-IdEe



SHPr-EmEr

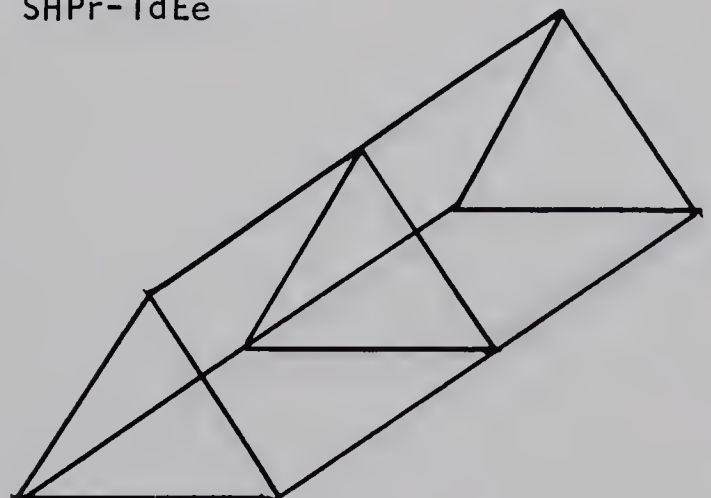
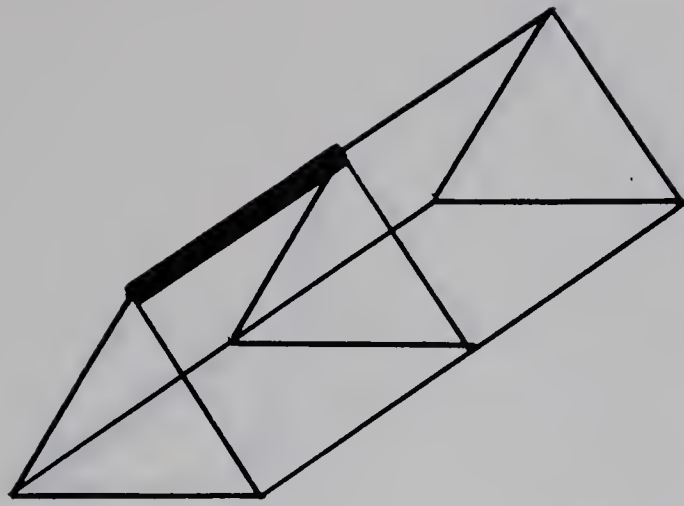


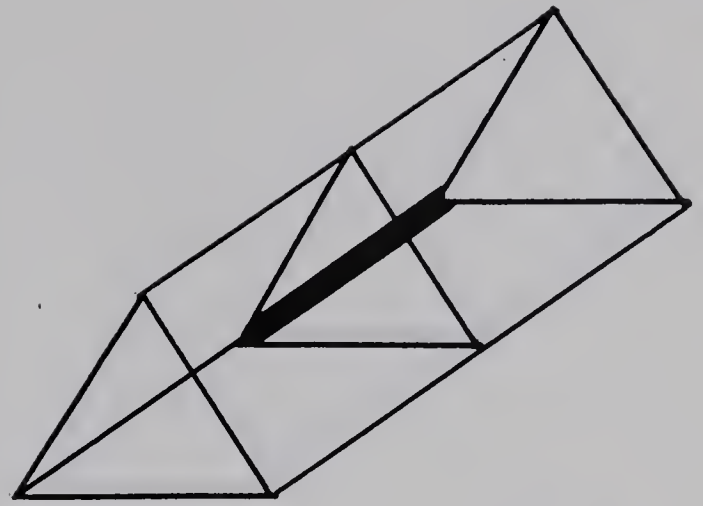
figure X

Type I or Initial Contacts Including the  
State Health Provider

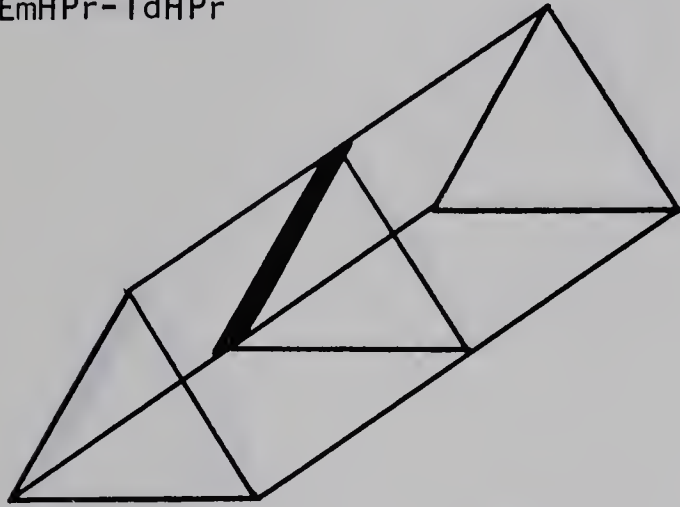




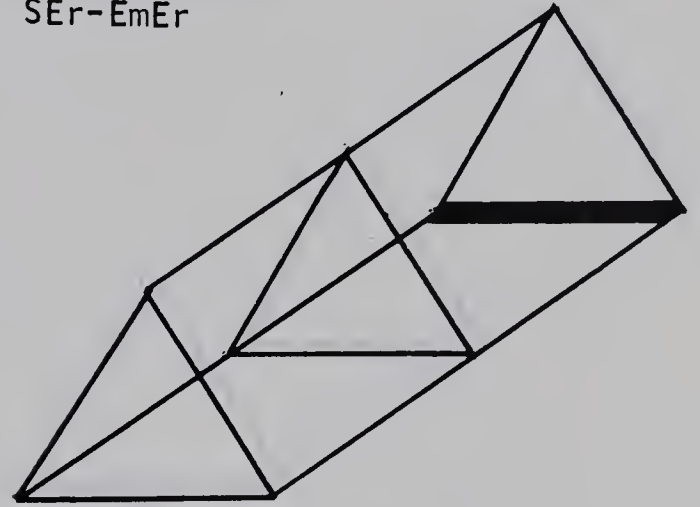
EmHPr-IdHPr



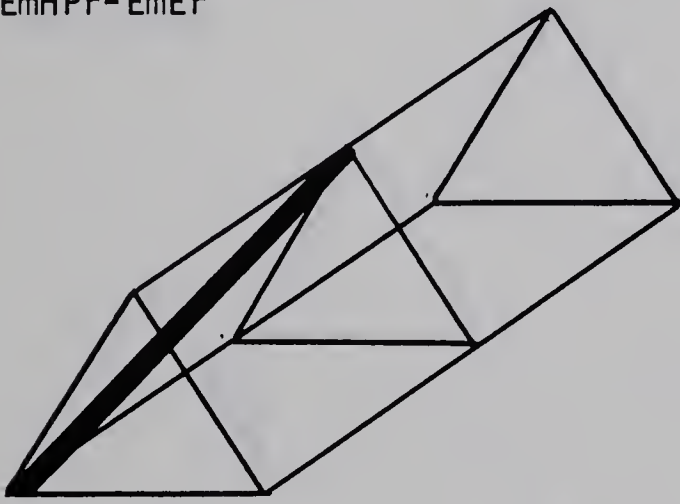
SEr-EmEr



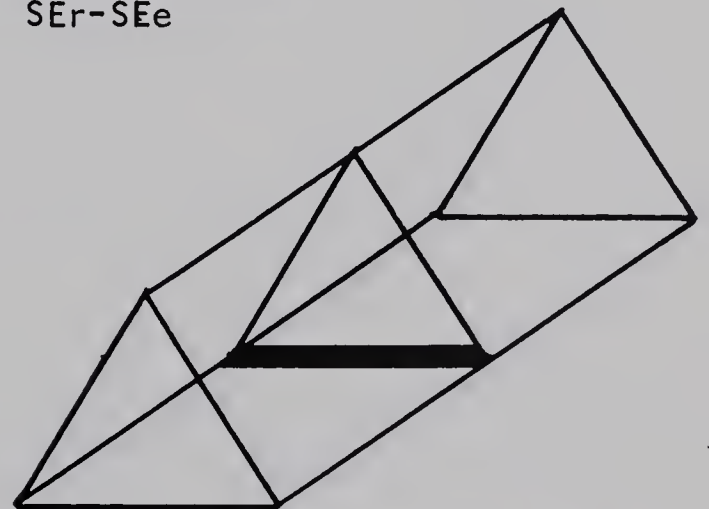
EmHPr-EmEr



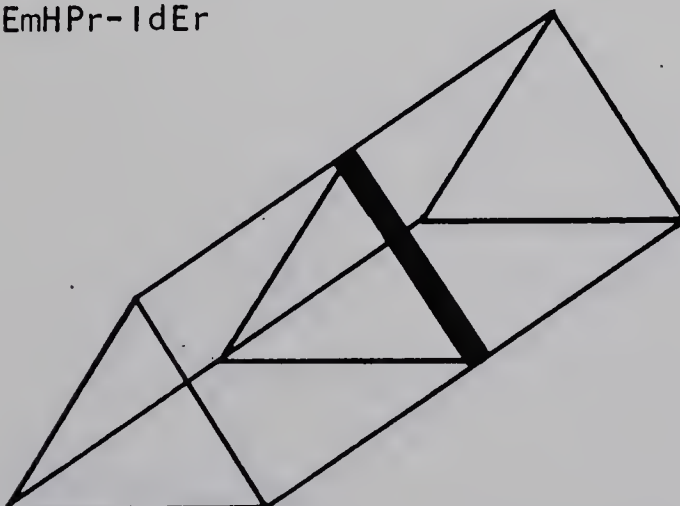
SEr-SEe



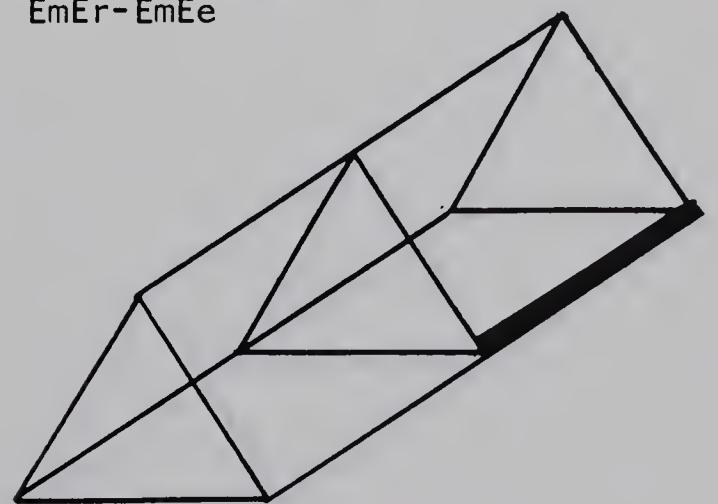
EmHPr-IdEr



EmEr-EmEe



EmHPr-EmEe



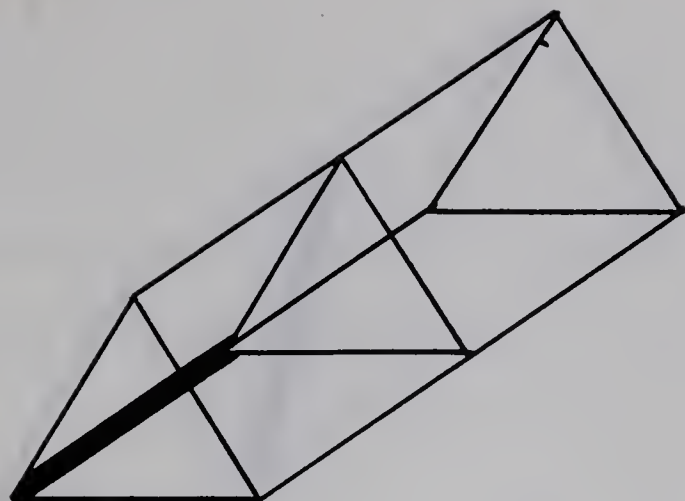
SEe-EmEe

figure XI

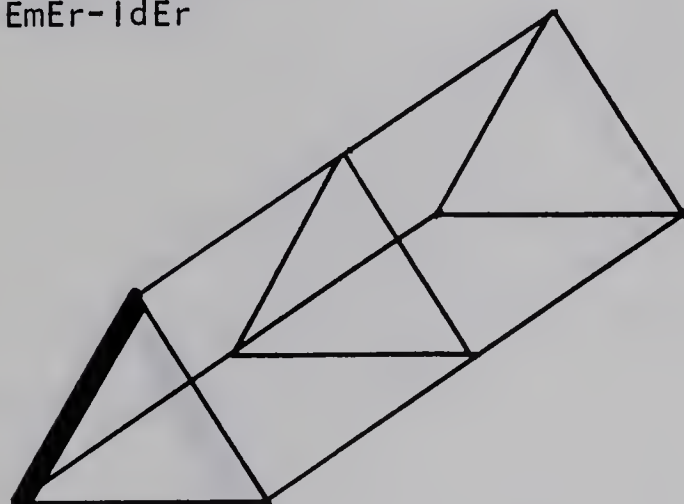
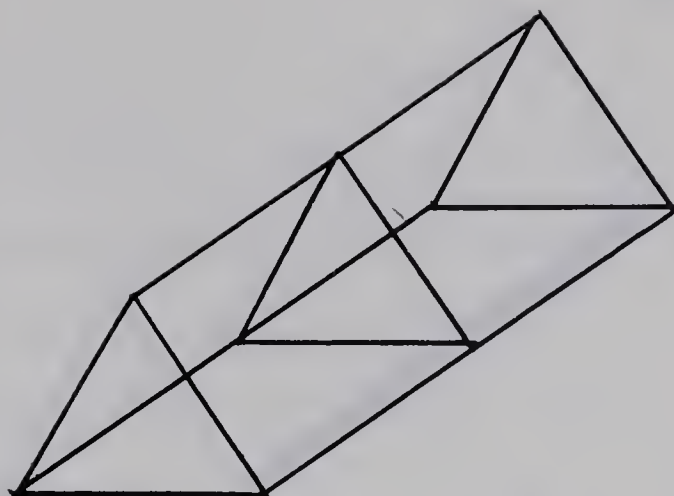
Type II or Intermediate Contacts







EmEr-IdEr



IdHPr-IdEr

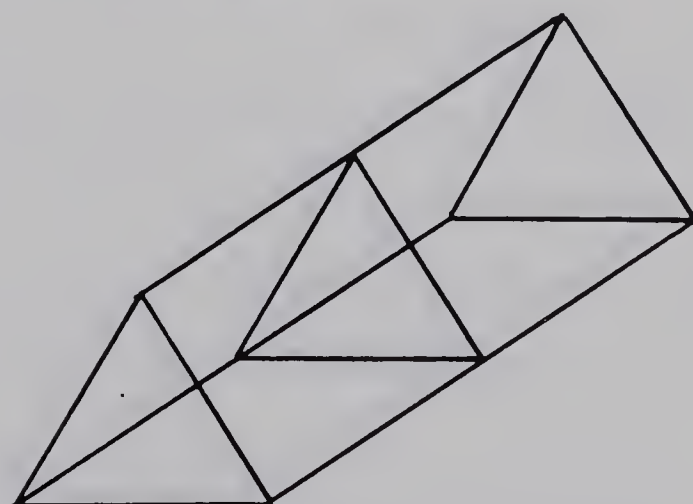
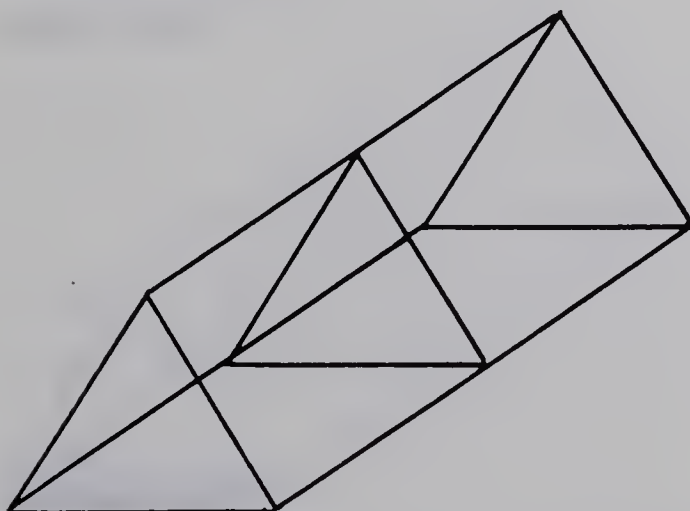
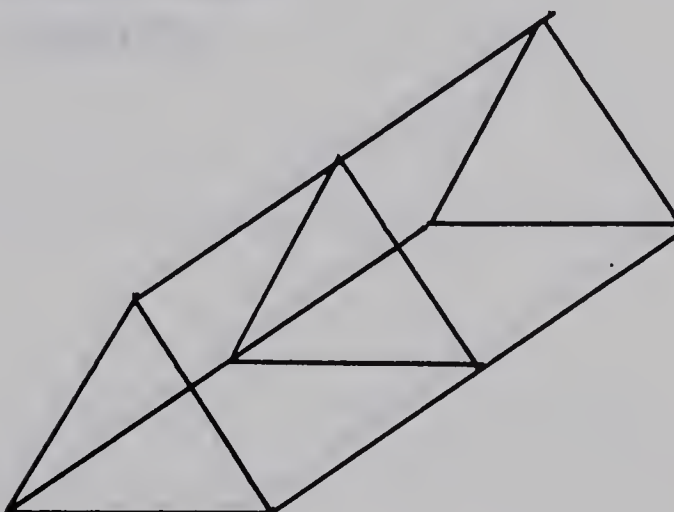
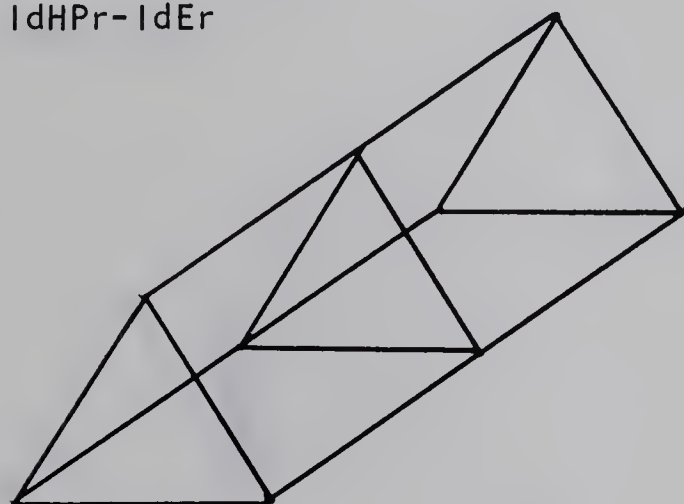
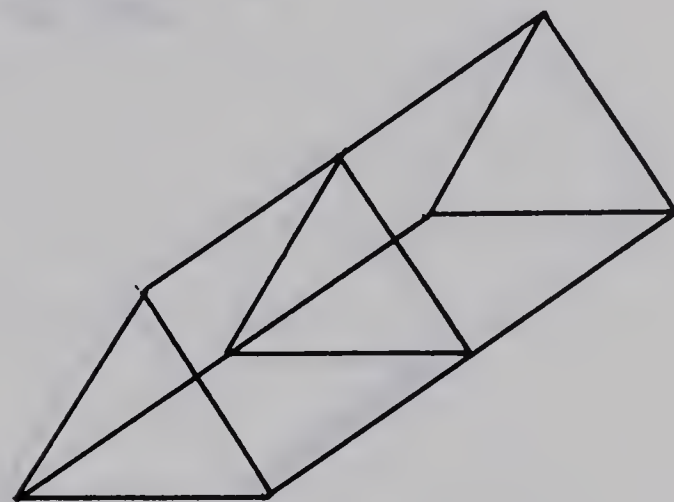
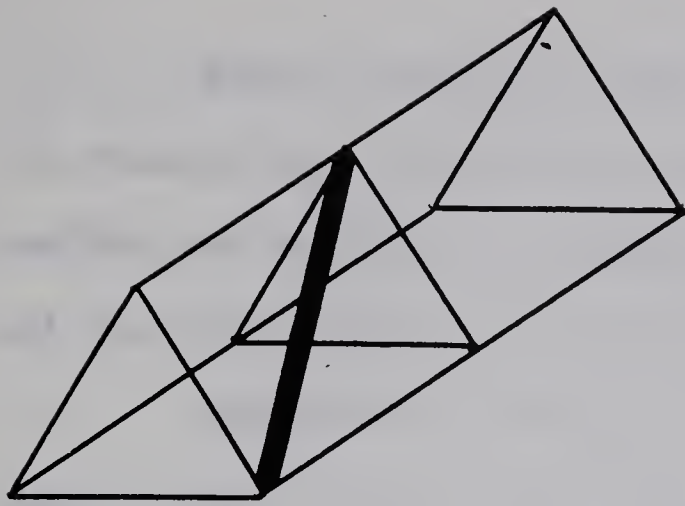


figure XI continued

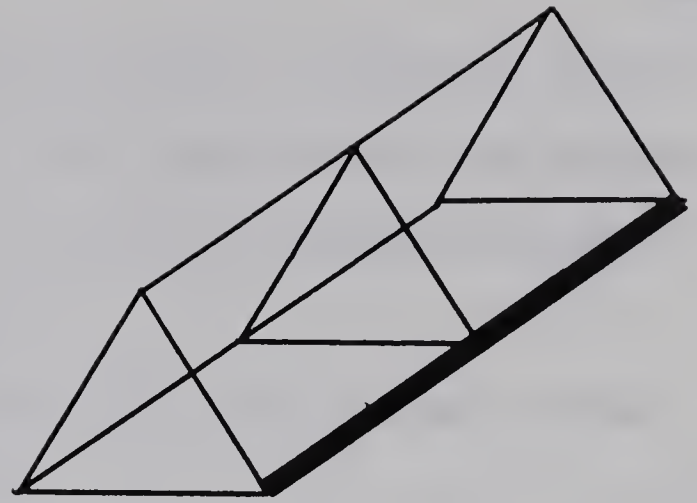
Type II or Intermediate Contacts







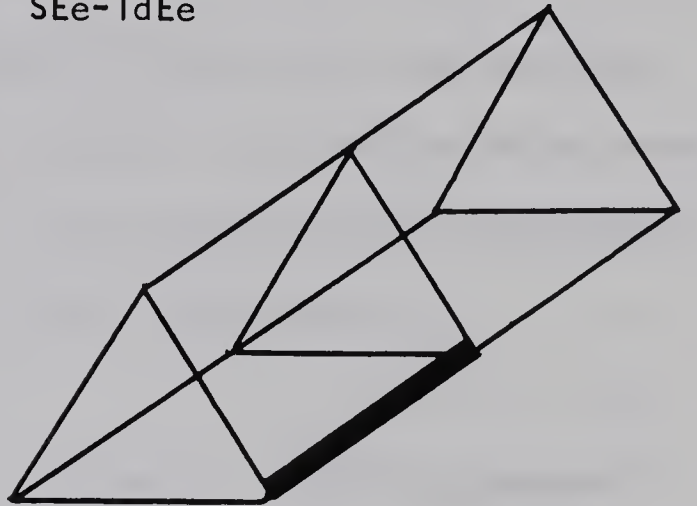
EmHPr-IdEe



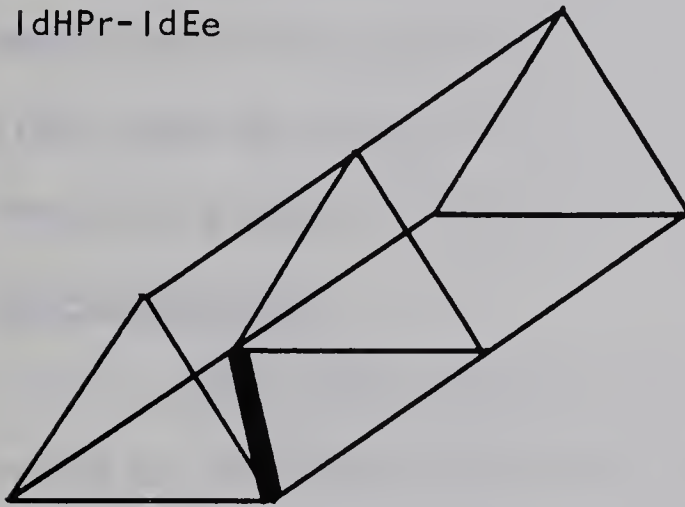
SEe-IdEe



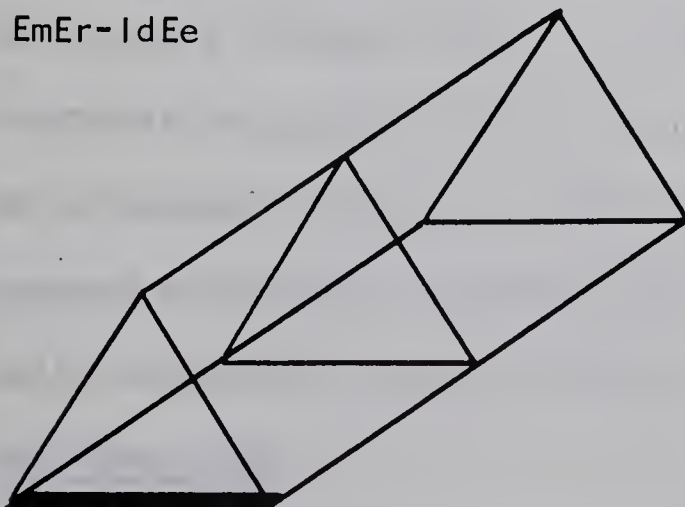
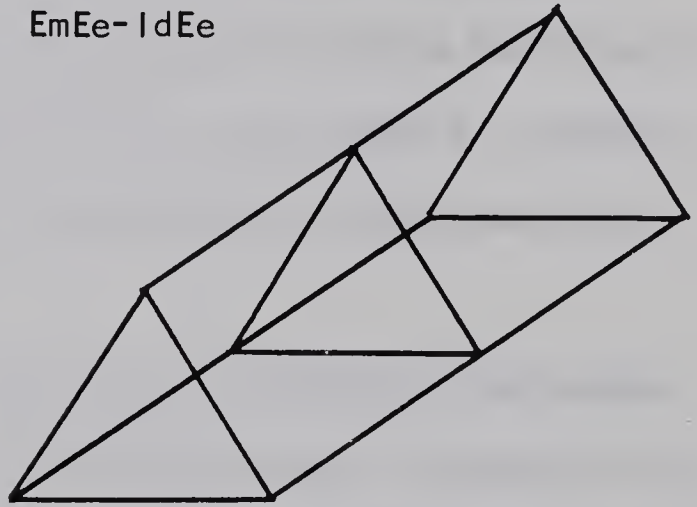
IdHPr-IdEe



EmEe-IdEe



EmEr-IdEe



IdEr-IdEe

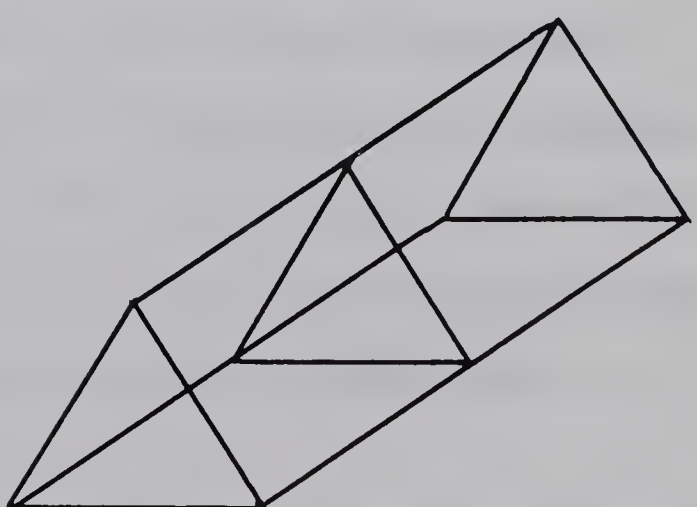


figure XII

Type III or Terminal Contacts Including the  
Individual Employee



Not all possible contacts are included in figures X, XI and XII, because some are unlikely parts in the communication line between the SHPr and the IdEe. For example, direct contact between the SHPr and the IdEr is possible, but unlikely.

The SHPr-IdEe contact is both initial and terminal. It belongs to type I as well as to type II.

A large variety of communication lines can be set up with the above outlined units. A role of the SHPr is to find out which ones will be the most effective in terms of the characteristics outlined in the beginning of this chapter. Some communications are:

#### SHPr-IdHPr-IdEe

This channel is one of the simplest in which the personal physician of the worker acts as an intermediate. The state health provider sends OD information to the physicians in the state or contacts them during their formal training at universities or at conventions.

#### SHPr-EmHPr-IdEe

The state health provider contacts the different employment health or safety services in the state. The latter pass information to the workers through pamphlets, posters, films or group discussions. Note that the group discussion can result in personal two-way exchange of information between an individual worker and the group leader. This becomes a IdHPr-IdEe contact. When the worker does not discuss but gets valid information just by listening, the contact is EmHPr-IdEe.

#### SHPr-EmEr-IdEe

The state health provider notifies the different employments in the state with PONE and explains that noise abatement regulations are valid at a specific time in the future. The EmEr who has, for ex-





ample, no health services can buy personal ear protection devices and inform the workers through a note put at the gate, indicating that earplugs can be obtained at the payroll office at the end of the week.

If the EmEr uses other means than personal ear protectors, such as enclosing the PONE sources, he may not need to contact the workers. This is an efficient SHPr-EmEr contact if the result is such that the safe levels are obtained.

#### SHPr-EmEr-EmHPr-IdHPr-IdEe

This type of communication already contains four basic units of the above outlined figures. For example, the state health provider informs the management representatives at a symposium (2) about PONE and OD. The latter demand their health services to collect data and to investigate the workplaces. A specific person, for example, an occupational nurse gets the task to inform the workers on the job. The nurse can let the workers try out earplugs while the machines are running. This method is proposed by Maas (71).

#### SHPr-SEe-EmEe-IdEe

The leaders of worker unions are informed by the state health provider about PONE and OD. The latter contact their representatives on the different employments. For example, the transport union leaders send information to union members of truck companies that they have to inquire for efficient mufflers. They can also recommend to the truckers, through the EmEe, that they run their motors more quietly than they are used to do.

Of course there are channels other than the ones already outlined. There are even accidental channels. The following is an example of such a case.



### SHPr-SEe-EmEe-EmEr-EmHPr-IdHPr-IdEr-IdEe

The representatives of the workers get notice from their union leaders about the possibility of noise in the plant. This issue is brought forward at the next joint consultation session. The EmEr asks the health services in the plant what this is all about. In order to avoid trouble, the latter people appoint a person to advise all the foremen and supervisors, who have to ask their workers to have their lunches away from the workshop, or at least in noise free places.

The EmHPr, in this example, is not supposed to receive information through the union representatives, but directly from the state health provider.

The validity of all the above channels has not been discussed. There is still information to be gained through studies about the value of a channel. It is the job of the SHPr to find out which ways are the best for the types of industry in their respective states.

## 2. Some Communication Inhibitors in the State Health Provider - Individual Employee Channels

Factors, such as time and space, have to be taken into consideration.

### Time

OD prevention can be limited because either the workers, the health providers, or other intermediates do not spend the time necessary for the spread of information. Some reasons are:

a) Policy of the management, such as priority to safety actions related to the work type, e.g., fire, explosion, noxious gas





control.

b) The management does not allow time off during working hours to inform the workers. Supervisors may be especially critical of health initiatives.

c) The workers do not want to be bothered during their working time when they are paid according to the production delivered.

d) Lack of interest during the off work periods, e.g., during lunch hours.

e) Lack of regular contacts with the health or safety services. This is the case where workers only get in touch with these services for treatment of accidental injuries or other emergency.

f) The difficulty of having the workers at the end of the work day in order to inform them. Brown (13:110) adds to this:

When the bell or the hooter goes at the end of the working day most workers are in a hurry to get home and a brief exchange of notes or verbal statements tends to be sketchy.

g) The HPr may fail to prevent the OD because of lack of training in that specific subject, or because of more apparently pressing health needs.

### Spatial Segregation

The physical distance between the workers, the management and the health provider, at any level, can enhance or diminish the contacts necessary to mitigate OD.

#### a) Geographical Spread

Some types of industry, like wood cutting, fishing, farming, oil drilling and pipe line construction, are frequently widely scattered or in isolated areas. In some of these cases, providing emer-





gency service is difficult. However, occupational health education is practically and financially not possible. In these cases, the HPr has to depend on written material.

b) In-Plant Spread

The in-plant services are often far from the places where the workers usually spend most of their work day. This is the case in mining. Contacts again are usually made only for emergency or visible ailments.

Brown (13:118) mentions:

The main disadvantage of the large concern, as is almost too frequently pointed out, is its impersonal nature and the difficulty of communication which is a direct result of its size. The corresponding advantage of the small firm is that problems of communication are less acute and the face-to-face relationship of employees to management should make the resolution of conflicts simpler.

The author emphasizes the psychological aspect more than the physical aspect of the communication deterioration. His comment is also valid in the case of the physical distance.

c) Employee Spread

Industrial modernization does not only result in the increase of PONE but also in the isolation of the worker from his fellow workers and his immediate supervisor. Tannenbaum (105:26) cites as an example the sudden loss of informal communication because of the introduction of large and noisy machines only requiring a small number of workers. The same kind of spread happens to truckers and weavers.

d) The Health Provider - Industrial Population Density Ratio

The density ratio of health providers to workers can be disproportionate in some states. The number of people that each nurse or doctor is responsible for, or the number of factories under control by



the state health provider, can be so large, that health provision is no longer efficient.

#### Inhibitors Other than Time and Space

Contact between the SHPr, the IdEe and the intermediates is reduced because of the functional diversity, being of an educational, socio-economic, or job specificity nature.

Brown (13:111) mentions:

It is easier to coordinate units doing similar work than those which are performing widely different functions. It is therefore easy to see why conflicts should arise between the various levels of the line organization, since in this case functions differ so widely that it is genuinely difficult for members of one level to appreciate what the other levels are trying to do.

Brown further mentions the difficulty of the supervisor or IdEr position which is under pressure from above to produce more, and he is equally under pressure from below to understand the viewpoint of the men he controls.

Friction is frequent between staff and personnel involved in productivity and those of maintenance. The former claim a higher, but unwritten status. Engineers, assembly supervisors, and workers, feel superior over economists, machinery controllers, secretaries, and others. The health service is also considered as a maintenance function, and perhaps, therefore, it has only limited influence among the industrial population. It might be that the magic of the physician's degree is reduced to bare emergency specialization among top management.





### 3. Communication Methods

Two methods can be applied to change the attitudes of the IdEe. The printed material method consists of the spread of pamphlets, posters, exhibits, films, which is a one-way or traditionally didactic method.

The interaction method consists of discussional interchanges between the health providers and their clientele. This is a two-way or Socratic method.

Patterson (83) mentions:

The industrial population is a section of the public where little attempt has been made yet to apply special approaches. The major percentage of our working population which is employed in the small industries has not yet been exposed to any type of health education other than through general methods of newspapers, radio, TV, and others.

The SHPr has to decide which method has to be used or in which degree both methods can be used.

#### a) The Printed Material Method

What are some of the insufficiencies of printed materials?

Felton (29) mentions:

The availability of documents per se, irrespective of their soundness or worth, does not comprise a health education program, nor does the giving and receiving of such materials imply learning.

In a further following of the conventional health education program, there becomes apparent the lack of ties of the material or the method with the group's habits, traditions, attitudes, or motives.

The Institute for Social Research, University of Michigan (50) states:

Printed matter can prepare the way for new ideas but seldom is crucial in bringing these ideas into actual



realization.

The same author mentions further that information materials which are suitable for managers are not suitable for the health services, and vice-versa. The manager does not expect to understand the details of a health problem improvement. He forwards all health matters to staff specialists for evaluation. Managers do not read materials submitted by the doctor or the nurse.

The Institute for Social Research, University of Michigan, notes that managers prefer printed material over personal contact for health matters, although they prefer personal contact over printed material for business matters. See table VIII.

Glorig (36) notes that the response from sending out 50,000 documents "Guide for Conservation of Hearing in Noise", has been slow, though these have been given reasonable publicity in the United States and in Canada.

Hazen, Roberts and Young (43) note that pamphlet and poster programs are by far the easiest to institute in industry because of time limitations, production schedules, space available for health education, and management interest. However, the value of these media when used alone, is questionable. The same authors also mention that managers have complained that the materials received are not interesting. The employees have considered them unfavorably in comparison with other mass media, such as newspapers and TV.

#### b) The Interaction Method

Felton (29) is a defendant of the two-way occupational health communication method based on discussional interchanges. This method is valid for all of the above mentioned communication units.





Managers would like:	No doctor or nurse in the employment	Doctor or nurse in the employment	Doctor and nurse in the employment
Printed material only	% 54,9	% 61,1	% 66,6
Both printed and verbal but prefers printed	4,8	3,7	4,8
Both	3,6	11,1	9,5
Both but prefers to talk with some one	3,2	-	-
Only to talk with someone	3,6	-	4,8
Do not want any information	30,1	22,2	14,3
Not ascertained	1,8	1,9	-
	100 % N = 166	100 % N = 54	100 % N = 42

table VIII

Preference by Managements with Different Staffed Services when Asked how to Receive Health Education Information Either Printed, Verbal, or a Combination of Both.





Felton and the Expert Committee of the World Health Organization (29) note:

The Socratic design assumes that people possess certain feelings, interests, beliefs, and information which deeply affect the learning process, and which must be considered before they can be changed or left unaltered. In health education activities based on these principles, two or more people, with different levels or kinds of knowledge, work jointly on a small parcel of information, to integrate it with the group's current ideas and with the objective of positive group action. In these settings, the free group discussion provides opportunities for questions to be asked, for ideas to be contributed, and for souls to be unburdened. In the words of the committee, "the discussion group is in itself a new group to which the individual can feel he belongs and from which he can get courage and protection.

Hunter (49) mentions that the contribution of the person to be motivated may be of little value in itself but important in the health education process.

The psychological effect on work people of having been consulted is more important as a rule than is the actual contribution of ideas made by them.

Maas (66), Beales (9), Sataloff (91), and other authors mention that the explanation of the value of personal hearing protection is very important to the workers. The workers frequently do not show up, when personal hearing protection is available.

Maas (67) notes:

The occupational nurse has to learn to recover from the disappointment that workers just do not rush to the health service for earplugs when they are told they are available.

Furthermore the IdEe must have the impression that the EmEr has done everything possible to reduce noise and that personal hearing protection is the last means he wanted to use. If he is not convinced of this, he will refuse the earplugs and earmuffs (64).



An important question to the SHPr is "By which representatives can the EmEr be reached best?" Data from the Institute of Social Research, University of Michigan (50), can probably give an indication. The problem in their study has been "How to introduce health education in plants by contacting the EmEr?" One of the conclusions is, that willingness to have health services is greater if the manager has talked with an industrial physician, but not if he has talked with other kinds of doctors. See table IX. The most frequent health information contacts for managers are those made when visiting other companies (50).

The reduction of the occupational hearing loss what concerns the communication, is dependent on improvement in the understanding of the interests of all involved individuals and groups by all the health providers.





	Management has discussed with:		Management has not discussed with any doctor
	Industrial doctor	Other type of doctor	
	%	%	%
Willing to have medical personnel	36,8	9,5	10,3
Not willing to have medical personnel	42,1	52,8	51,0
Willingness not ascertained	21,1	37,7	38,7
	100 % N = 19	100 % N = 53	100 % N = 145

table IX

Willingness of the Management to Have Medical Personnel after Being Consulted by Different Types of Doctors.



## CHAPTER VII

### SUMMARY AND CONCLUSION

Occupational deafness is the resultant of two factors. They are the emission of harmful noise and the damage occurring to the ears of the worker. The cause of this disease is also to be considered on the basis of the involved people. These are:

- 1) The employer (Er) who allows the occurrence of the hazard in the employment.

- 2) The employee (Ee) who is exposed to the excessive noise and who undergoes the hearing loss.

- 3) The authorities who have to mitigate the occupational health hazard. These are called the health providers (HPr). They can be the personal physician of the employee, the industrial hygienist, the occupational health nurse, the law enactor, the state occupational health services for industry, etc.

Glorig and other authors have proposed to mitigate occupational deafness (OD) through combined action with management, labor force and the health provider. Up to the present time there has been no structure used to find out systematically which factors are causative to the occurrence of OD, other than fragmented contributions by different disciplines. There is a need for the integration of the already collected evidence on a valid pattern, as well as a sound structure for the future investigation of the occurrence of OD.

A basic interaction is proposed and justified between the



employer, the employee, and the health provider. The triangular model is enlarged in a third dimension, containing five levels. These are the individual, the employment, the state, the national, and the international levels. The three elements of the triangular model and the five levels can be combined to fifteen units of involvement with occupational deafness.

A set of indicators is proposed for the investigation of the occurrence of OD. These are:

- a) Description of the fifteen units.
- b) Responsibility of each of these units to occupational deafness prevention.
- c) General non-technical causes. These are causes which are similar to other occupational diseases.
- d) Specific non-technical causes. These are existent only for occupational deafness.
- e) Communication between the fifteen units.

The above parts have been represented in a block model with:

#### Dimension One

The basically involved members such as the health provider, the employer, the employee.

#### Dimension Two

The levels which are the individual, employment, state, national and international.

#### Dimension Three

The inquiry types as outlined above in a, b, c, d and e.

The set of indicators is worked out for the individual, the





employment, and the state level. The state can be considered as the territorial unit with relative autonomy, with legal and technical power, and independent from the national and international authorities. The general non-technical and specific non-technical indicators are combined in a series of essential factors to be reviewed.

The model has to be considered as an introduction to further research and not as final conclusive evidence. Data collected by health authorities to the present time are more of a technological nature than of a social one.

There are three stages in which OD can be located. These three stages are valid for the individual, the employment, and the state levels.

1) Latent awareness of OD and its impact. The HPr, the Er, the Ee, do not know the presence of the hazard and therefore do not counteract it. It may be that the occurrence is known but that there is no interest in the mitigation.

2) Conscious awareness of the health hazard and its consequences. The HPr, the Er, and the Ee, are aware of the occurrence of OD, but the preventive action is limited for administrative, technological, or financial reasons.

3) Cooperation between the health provider, the employer, and the employee. There is a realistic interest by all partners to mitigate OD. The communication between the HPr, the Er, the Ee is efficient and the elimination of the health hazard is close by.

A preliminary review of relevant factors may indicate the occurrence of occupational deafness.



1) The clinical definition of OD is already outlined by the medical discipline. However, the conceptual definition is not, and medico-legal problems are frequent. It has not been determined, as yet, whether OD is a disablement, an injury, or an impairment. Some Northern American states compensate OD only when it belongs to a specific classification. Differences in conceptualization lead to the delay of OD mitigation.

2) Because OD is a physical affliction, the medical authorities claim the overall direction in the prevention program. Their attitude is exaggerated because OD cannot be cured, only be prevented. Industrial hygienists, occupational health educators or administrators and others have at least the same ability to lead a prevention program in industry or at the state level. The medical authorities have not yet proven an exceptional capacity in administration on the basis of formal training. The OD investigations have usually been limited to the medical aspect of the problem. The medical authority should not be neglected, but the leadership of the prevention programs should be appointed according to the circumstances. However, the occupational nurse or the physician can be the most convincing on the individual level. The lack of efficient leadership is still wide spread on the employment and the state level.

3) The general public is used to increasing noise levels in the community and on the occupation. The noise level is increasing yearly by one decibel in Northern America. Also the general public is unaware of the mental and social impact of OD.

4) Industry and the health provider have not yet decided which priority to give to OD prevention. However, one is reminded that







more workers are exposed to excessive noise than to any other occupational disease.

5) There is a wide variety of standards used throughout Northern America in order to protect the largest population possible. Most authors agree that not all workers can be protected, because of the expense to management. Some state health providers may be well influenced by the industry when they set up safety standards for their area of responsibility.

Acousticians and theoretici have varying proposals for adequate damage risk criteria. A graph with an envelope of seven damage risk criteria is presented. A difference of five to ten decibels is continuous between the top and the bottom line, even in the delicate speech frequencies.

6) Health providers who are well educated in their speciality must learn OD prevention after being appointed to their job, because they do not receive adequate instruction in occupational health in their formal training.

The labor force and the management fail to give the HPr the right status. Wages are often too low to attract health providers to industry or state organizations. There is also a drain of specialists to new health specialities. The available health personnel is often used for jobs different from the training potential. Furthermore there are HPr who are not interested in their preventive role and who serve inadequately.

7) Management is exposed to many pressures such as taxation, trade, labor training and turn over, welfare, workmen's compensation regulations, factory inspections, investment, enterprise, etc.



Occupational health may be neglected because of some of the above mentioned pressures. Furthermore, the managers have ethical viewpoints which serve their purposes but not always the health of their workers. Also, managements are often doing as their business associates do. They are sensitive to innovations which can improve their status among colleagues and their customers. OD prevention is not an obvious means to improve this condition. Managers also wait for OD prevention and look at what happens to accused firms in court decisions.

8) Some managements do not permit the cooperation of the labor force in decision making regarding company policy. There has to be a mutual trust between labor force and management in order to introduce an effective OD prevention program.

9) The unions have not yet efficiently spread the information about the OD impact to their representatives at the plants and to the individual workers. They do not want to bother the labor force because they are not themselves well informed about OD. They are basically opposed to innovations which they suspect result only in advantages for the management.

10) The HPr faces difficulties in the presentation to the management of OD prevention because of the nature of the program. For example, a "Better nutrition" program is not a threat to the employer; however, the OD prevention is a suggestion that the work place or the work procedures used are hazardous and that the cost will be born by the manager.

11) Several authors are convinced that work conditions do not affect the job morale and therefore do not initiate complaints. Noise is interpreted by some workers as suggestive of power. The more





noise there is, the more work seems to be performed. Continuous noise is the most frequently appearing noise type and workers generally get used to it easily.

12) The worker with a hearing problem refuses to look for advise or refuses to complain because hearing loss does not make him look different from other people. He is bound to his work environment by the friendship of other workers, because of the appreciation his supervisor has for him, and he feels that this is the place where he is useful and makes the right contributions. He is insufficiently informed of how to make full use of the health services. He is afraid to be down graded or to fail promotions or benefits, when he files a claim. The worker with potential OD is in a dilemma. Either he has to file claims and may feel in conflict with his company or he hides his problem which results in a mental strain. He has to go through a long administrative procedure before his claim can be accepted. Compensation boards do not recognize mild degrees of hearing loss and employers are reluctant to accept responsibility for hearing loss due to non-occupational causes.

Communication is a part of the block model. Contacts in the HPr-Er-Ee set are possible because of many two-way communication units. Chains of communication can be built between the state health provider and the individual employee. Every state health provider has to find out on the basis of experience and professional judgement, which avenue has the best chances for information spread of OD prevention. A few suggestions may be helpful:





a) The less intermediates are used, the less contamination and delay of information there will be.

b) The individual health provider should be part of every chain, because of the experience with the worker as an individual.

c) Written information can be good, but will be more efficient, when it is used together with verbal presentation of OD prevention.

d) The labor force and the employer are to be contacted by the health provider of their level. This means, for example, that the best information is given to the management by the employment health provider.

If the state health provider decides to improve the OD prevention in his area of responsibility, the following pattern can be used:

1) Decision regarding leadership of the program and specific outline of the roles of all the members.

2) Review of:

The actual legislation,  
Conceptualization of OD,  
Standards being used,  
Priority already given to the program of OD prevention.

3) Review, on basis of the three dimensional model, of the channels of communication that have been used in the past and their deficiencies.

4) Decision regarding new or better channels on the basis of information from industrial sociologists, occupational health educators and other experienced observers of industry.



5) Increase the quality of the material sent through channels. Usually advise is given about prevention methods, however, the effect of gradual hearing loss on the personal life of the exposed worker is not included. OD is too often minimized.

6) Understanding of the high cost to industry of drastic changes in equipment. Decision on a transition period in which new laws forbid the purchase of noisy machinery.

7) Constant review of the efficiency of OD prevention.

Occupational deafness will not be mitigated as long as the state health provider does not use a logical pattern of operation and as long as the actual status is only partially reviewed. The modus of operation is to be decided by each state health provider as such, because each state will have its own characteristics which can affect a general program. The material presented can be used as an introduction or as a guide to action. The model and the suggested factors of investigation still need refinement, and qualitative and quantitative evidence. However, this preliminary contribution is set up in such a way that addition of factors to be reviewed, or levels to be added in the three dimensional model with the five levels, will not change the basic outline, which is not only valid for the investigation of occupational deafness but also for other occupational diseases.





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**B29905**